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OHIO RIVER BASIN
TRIBUTARY TO WHITELEY CREEK
GREENE COUNTY

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PENNSYLVANIA

NDI No. PA 00197

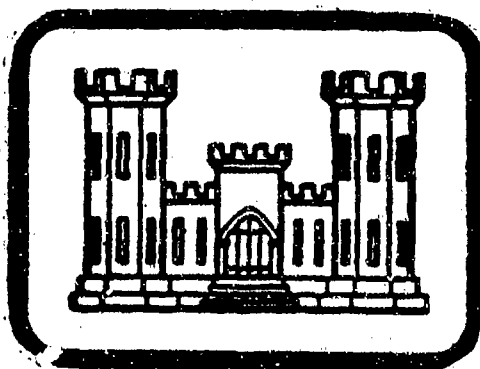
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LEVEL II

ROBENA SLURRY POND 6

UNITED STATES STEEL CORPORATION
RAW MATERIALS DIVISION
FRICK DISTRICT

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
BALTIMORE, MARYLAND 21203

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JULY 1981

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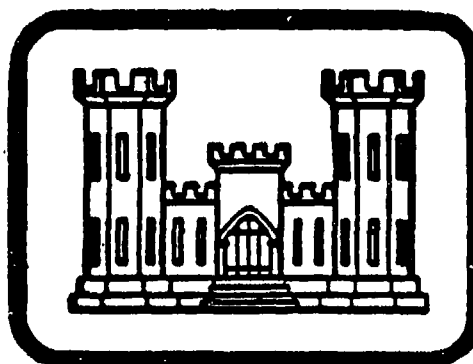
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OHIO RIVER BASIN

ROBENA SLURRY POND 6
GREENE COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI NO. PA 00197
PennDER NO. 30-26

UNITED STATES STEEL CORPORATION
PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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DACW31-81-C-0027

Prepared for: DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

Prepared by: ACKENHEIL & ASSOCIATES GEO SYSTEMS, INC.
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Date: July 1981

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon visual observations and review of available data. Detailed investigations and analyses involving topographic mapping, subsurface investigations, materials testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some time in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" (PMF) for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS

NAME OF DAM: Robena Slurry Pond 6
STATE LOCATION: Pennsylvania
COUNTY LOCATION: Greene
STREAM: Unnamed tributary to Whiteley Creek.
DATE OF INSPECTION: 20 May 1981
COORDINATES: Lat. 39°49'50"
Long. 79°57'12"

ASSESSMENT

Based on a review of available design information, visual observations of conditions as they existed on the date of the field inspection, and supporting calculations, the general condition of Robena Slurry Pond 6 is considered to be good.

The structure is classified as a "large" size, "significant" hazard dam. Corps of Engineers guidelines recommend the Probable Maximum Flood (PMF) as the Spillway Design Flood for a "large" size, "significant" hazard dam. Robena Slurry Pond 6's Spillway Design Flood is the Probable Maximum Flood. Spillway capacity is "adequate" because the non-overtopping flood discharge was found, by using the HEC-1 computer program, to be in excess of 100 percent of the PMF.

No emergency operation and warning plan was found for the facility.

The field inspection indicated very minor deficiencies which can be corrected or improved as a part of normal maintenance efforts.

RECOMMENDATIONS

1. Emergency Operation and Warning Plan: The owner should develop an Emergency Operation and Warning Plan including:
 - a. Guidelines for evaluating inflow during periods of heavy precipitation or runoff.
 - b. Procedures for around-the-clock surveillance during periods of heavy precipitation or runoff.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Robena Slurry Pond 6

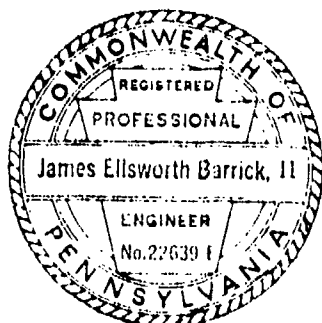
c. Procedures for drawdown of the reservoir under emergency conditions.

d. Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

2. Maintenance and Inspection Procedures: The owner should develop written maintenance and inspection procedures in the form of checklists and step-by-step instructions.

3. Remedial Work: The Phase I investigation of Robena Slurry Pond 6 disclosed very minor deficiencies which should be corrected during routine maintenance. This would include repair of minor sloughing and minor erosion of slopes on and adjacent to the embankment.

Samuel G. Mazzella 17 July 1981
Samuel G. Mazzella Date
Project Engineer



James P. Hannar 17 July 1981
James P. Hannar Date
Project Engineer

James E. Barrick, P.E. 17 July 1981
James E. Barrick, P.E. Date
PA Registration No. 022639-E

Approved by:

James W. Peck 11 Aug 81
JAMES W. PECK Date
Colonel, Corps of Engineers
Commander and District Engineer

ROBENA SLURRY POND 6



OVERVIEWS

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
ROBENA SLURRY POND 6
NATIONAL I. D. NO. PA 00197
PennDER No. 30-26

SECTION 1
PROJECT INFORMATION

1.1 GENERAL

a. Authority: The Phase I investigation was performed pursuant to authority granted by Public Law 92-367 (National Dam Inspection Act) to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose: The purpose of the investigation is to make a determination on whether or not the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. General: Robena Slurry Pond 6 consists of an earth and rockfill (coarse coal refuse) embankment across an unnamed tributary to Whiteley Creek in Monongahela Township, Greene County, Pennsylvania. The impoundment is used to store fine coal refuse sediments and acid mine drainage "yellow boy" materials generated by United States Steel Corporation's Robena Mine complex.

(1) Embankment: The embankment was designed and constructed as a zoned structure consisting of a clay core, a random fill upstream shell and a coarse coal refuse downstream shell. The core traverses the centerline and extends to bedrock in a cutoff trench. The foundation rock was pressure grouted prior to embankment construction. The embankment is 1985 feet long (including spillway) and has a toe to crest height of 115.5 feet and a crest width of 20 feet. The embankment upstream slope is about 2.4H:1V. The downstream slope has 2 benches, each 20 feet wide and intermediate slopes of 2.4H:1V and 2.5H:1V. Near the downstream toe, the slopes range from 2.0H:1V to approximately 3.3H:1V.

(2) Principal Spillway: The principal spillway consists of a 20 inch diameter (nominal) steel conduit that connects an intake structure at the upstream end of the reservoir with an outlet structure below the downstream toe of the embankment.

The intake structure consists of numerous 90 degree, 12 inch diameter steel elbows welded to the conduit. The inlet ports are positioned in such a way that reservoir outlet control can be maintained as the bottom of the reservoir rises due to deposition of coal waste materials.

The principal spillway control and outlet structures are located at the downstream toe of the embankment. The control structure is a concrete box that contains a 20 inch butterfly valve. The outlet structure contains flow stilling and measuring devices.

(3) Emergency Spillway: The emergency spillway is an open channel cut into natural ground on the right abutment. At the flow control section the channel bottom is 10 feet wide with a left side slope of about 2H:1V and a right side slope of about 4H:1V. The channel is riprap lined for approximately 2,300 feet.

(4) Downstream Conditions: Pond 6 principal spillway flows are discharged into Robena Slurry Pond 4, which is approximately a quarter mile below Pond 6. Pond 4 discharges via a concrete lined open channel to Whiteley Creek, approximately 7,500 feet upstream of the confluence with the Monongahela River.

Emergency spillway flows enter a natural drainway approximately 2300 feet below the dam and are ultimately discharged to Whiteley Creek.

The Robena Mine and Coal Preparation Plant lie on the Whiteley Creek floodplain below Pond 4.

(5) Reservoir: The Pond 6 reservoir was about 1,200 feet long at the time of the field inspection. When the reservoir level is at the crest of the emergency spillway, the pool will be 1,800 feet long. When the reservoir level is at the crest of the embankment, the pool will be 2,000 feet long.

(6) Watershed: The watershed contributing to Pond 6 is woodland and grassland. The reservoir comprises approximately one third of the watershed.

b. Location: Robena Slurry Pond 6 is located across an unnamed tributary to Whiteley Creek in Monongahela Township, Greene County, Pennsylvania, approximately three miles southwest of Masontown, Pennsylvania.

c. Size Classifications: Robena Slurry Pond 6 has a maximum toe to crest height of 115.5 feet. The maximum storage capacity impounded is 753 acre-feet. Based on this data, the Pond 6 is classified as a "large" size structure.

d. Hazard Classification: The Pond 6 is classified as a "significant" hazard dam. In the event of a dam failure, the Robena Mine complex could be subjected to substantial damage and loss of a few lives could result.

e. Ownership: Robena Slurry Pond 6 is owned by the United States Steel Corporation, Raw Materials Division, Uniontown, Pennsylvania. Inquiries concerning the dam should be addressed to:

United States Steel Corporation
Raw Materials Division
Frick District
5th Floor, Fayette Bank Building
Uniontown, Pennsylvania 15401
Attention: Mr. Robert Witt, Jr., Chief Engineer
(412) 438-3511 Ext. 256

f. Purpose of Dam: Robena Slurry Pond 6 was constructed as a storage facility for fine coal refuse slurry produced at the Robena Coal Preparation Plant.

g. Design and Construction History: Design drawings were prepared by L. Robert Kimball, Consulting Engineers of Ebensburg, Pennsylvania, in 1976. A permit to construct a dam on an unnamed tributary to Whiteley Creek was applied for on 8 December 1976 and approved by the Department of Environmental Resources on 24 April 1978. The dam and appurtenant structures were constructed by C. J. Langenfelder and Sons of Baltimore, Maryland, between October 1979 and September 1980.

h. Normal Operating Procedures: Pond 6 was designed to operate as an uncontrolled structure. Under normal operating conditions, fine coal refuse slurry is pumped from the preparation plant and is discharged onto the upstream slope of the dam. Pool level is maintained by the principal spillway structure located on the east (upstream) side of the pond. The emergency spillway crest is at Elevation 1051.1 to accommodate flows from a PMP type storm when the reservoir pool elevation is at the spillway crest.

1.3 PERTINENT DATA

a. <u>Drainage Area:</u>	0.10 sq. mi.
b. <u>Discharge at Dam Facility</u>	
Maximum Flood at Dam Facility	Unknown
Emergency Spillway Capacity at Top of Dam	257 cfs

c. Elevation (feet above MSL)

Design Top of Dam	1055.0*
Current Top of Dam (low point)	1055.2
Emergency Spillway Overflow Crest (average)	1051.1
Pool at Date of Inspection	1016.0
Inlet Invert of Principal Spillway	Varies
Toe of Embankment	939.7
Outlet Invert of Principal Spillway	935.7
Maximum Tailwater	Unknown

d. Reservoir Length

Maximum Pool	2000 feet
Pool at Emergency Spillway Crest	1800 feet
Pool at Time of Inspection	1200 feet

e. Reservoir Storage

Current Top of Dam	753 acre-feet
Emergency Spillway Crest	646 acre-feet

f. Reservoir Surface

Current Top of Dam	27.5 acres*
Emergency Spillway Crest	24.7 acres

g. Embankment

Type	Zoned Earth and Coarse Coal Refuse
Length	1985 feet
Height	115.5 feet
Crest Width	20 feet
Slopes	
Downstream	2.4H:1V to 2.5H:1V
Upstream	2.4H:1V
Impervious Core	Yes*
Grout Curtain	Yes*

h. Principal Spillway (Regulating Outlet)

Type	20 inch Diameter (Nominal) Steel Pipe with Intake Ports at Various Levels
Crest Elevation	Varies
Gate Valve	Yes, at downstream toe of Embankment
Conduit Length	2117 feet*
Upstream Flow Control	Yes
Anti-seep Collars	Yes*

1. Emergency Spillway

Type	Trapezoidal Open Channel
Length of Crest	10 feet
Side Slopes	2H:1V and 4H:1V
Crest Elevation (average)	1051.1
Approach Channel Slope	2%
Discharge Channel Slope	3%

*Taken or derived from design drawings.

SECTION 2 ENGINEERING DATA

2.1 DESIGN

a. Design History: Robena Slurry Pond 6 was designed by L. Robert Kimball, Consulting Engineers of Ebensburg, Pennsylvania, in 1976. After objections by the Pennsylvania Fish Commission were resolved, a permit to construct and maintain a dam across an unnamed tributary to Whiteley Creek" was issued on 24 April 1978 by the Pennsylvania Department of Environmental Resources.

b. Data Available: Data available for review included:

(1) The contents of PennDER files consisting of correspondence between owner's representatives and state personnel, portions of the owner's original permit application, two state reports on the proposed design, and state and owner's construction progress reports.

(2) "Engineering Report . . ." and "Construction Specifications . . ." for the facility prepared by L. Robert Kimball, Consulting Engineers of Ebensburg, Pennsylvania.

(3) Design drawings prepared by L. Robert Kimball that were provided by United States Steel Corporation for review and reproduction.

(4) Discussions with a company representative during the field inspection of Robena Slurry Pond 6.

2.2 CONSTRUCTION

a. Constructor: The dam was constructed between October 1979 and September 1980 by C. J. Langenfelter and Sons of Baltimore, Maryland.

b. Modification: There are no reported modifications to the structure after its completion.

2.3 OPERATION

a. Dam: The dam was designed to operate without a dam tender and no operational data are available.

Monitoring instrumentation is maintained and records of readings are on file with the Robena Mine Manager. The most recent readings were provided by the owner's representative and are included as page A11, Appendix A.

b. Principal Spillway: The principal spillway requires periodic attention because of the constantly rising level of coal waste materials in the impoundment. As the refuse rises, successive inlet ports of the principal spillway intake structure are sealed off. Consequently, only a small amount of free water is impounded at any given time. An inlet port is sealed when there is insufficient free water to permit adequate settling of waste fines.

c. Emergency Spillway: The emergency spillway is an uncontrolled, open channel on the right abutment. It does not require the attention of operating personnel and needs only periodic maintenance.

2.4 EVALUATION

a. Availability: Available information was obtained from the Pennsylvania Department of Environmental Resources and was supplemented by drawings received from and conversations with a representative of United States Steel Corporation, the Owner.

b. Adequacy: The available design information, supplemented by field inspection and supporting engineering analyses presented in succeeding sections is adequate for the purposes of this Phase I Inspection Report.

c. Validity: There appears to be no reason to question the validity of the available design information and drawings.

SECTION 3 VISUAL INSPECTION

3.1 FINDINGS

a. General: The field inspection of Robena Slurry Pond 6 was performed on 20 May 1981 and consisted of:

- (1) Visual observations of the embankment crest and slopes, groins and abutments;
- (2) Visual observations of the principal and emergency spillways, including intake structures, outlet structures and approach and discharge channels;
- (3) Visual observations of the embankment's downstream toe area including drainage channels and surficial conditions;
- (4) Visual observations of downstream conditions and evaluation of downstream hazard potential;
- (5) Visual observations of reservoir shoreline and watershed;
- (6) Transit stadia field measurements of relative elevations along the embankment crest centerline, emergency spillway and across the embankment slopes.

The visual observations were made during periods when the reservoir and tailwater were at normal operating levels.

The visual observations checklist, field sketch, field profile and field section containing the observations and comments of the field inspection team are contained in Appendix A. Specific observations are illustrated on photographs in Appendix C. Detailed findings of the field inspection are presented in the following sections:

b. Embankment:

(1) Crest: The crest of the embankment was approximately L-shaped in plan and appeared to be in accordance with construction drawings provided by the owner's representative. No offsets or indications of misalignment were observed that would indicate anomalous movement of the embankment.

Vertically, the crest was somewhat higher in the center than at the abutments. This observation was confirmed by design plans which indicated that a five foot camber had been constructed into the dam. A small depression was observed near the left center of the embankment where the slurry and yellow boy pipelines crossed the crest of the embankment.

The crest was entirely covered with a layer of gravel sized sandstone fragments. No vegetation was observed growing through and no depressions or wheel ruts were observed.

(2) Upstream Slope: The entire upstream slope of the embankment was covered with a uniform blanket of riprap erosion protection. The riprap consisted of sandstone materials ranging in size from gravel through boulders of 36 inches in diameter.

The slope was generally uniform from crest to water level and from abutment to abutment. No erosion or indication of slope instability was observed anywhere on the upstream slope.

(3) Downstream Slope: The downstream slope was divided into three slope segments separated by two gravel covered benches. The slope portions were generally grassed and contained only minor erosional gullies and minor topsoil sloughing. The slopes were uniform from crest to toe and from abutment to abutment. There were no observed indications of significant erosion or slope instability.

The left groin (junction of embankment and left abutment) contained a small diversion channel that was either grassed or contained minor erosion. This channel passed beneath the dam's access road via an 18 inch diameter corrugated metal pipe culvert that, on the date of inspection, contained a flow of approximately 1 to 2 gallons per minute.

The lower left groin, the entire right groin and the entire embankment slope below the lower bench were covered with riprap similar to that on the embankment's upstream slope. No significant erosion or instability was observed anywhere along these riprapped areas; some minor erosion was noted.

c. Abutments: Both abutments were cleared of trees and brush and appeared to be in good condition. There was no evidence of seepage, erosion or slope instability anywhere on either abutment. Both abutments contained a stand of recently germinated grass and appeared to be in an immediate post-construction stage.

The left abutment contains a gravel covered access road that lies immediately below the downstream toe of the embankment.

d. Principal Spillway:

(1) Intake Structure: The principal spillway intake structure was in good condition. There were no indications of rusting of the conduit or the inlet ports and no clogging of trash cages was observed.

(2) Control Structure: The principal spillway control structure was in good condition. No significant cracking or concrete deterioration was observed. Steel components were either painted or had only minor surface rust. The flap valve appeared to be in good condition but was not activated (closed) to check its operability.

Some minor dampness was observed on the base slab of the control structure at an elevation well below adjacent ground level.

(3) Conduit: The conduit, as observed in the control structure, appeared to be in good condition.

(4) Outlet Structure: The principal spillway outlet structure appeared to be in good condition. No cracks or deterioration of concrete surfaces was noted.

The flow measuring weir at the downstream end of the outlet structure contained some corrosion or encrustation, but this condition did not appear to significantly effect the weir's measuring capabilities.

(5) Discharge Channel: The discharge channel below the outlet structure was lined with riprap for a distance of approximately 50 feet. The channel then enters a six foot diameter concrete pipe with concrete headwall and wingwalls that carries flow beneath the access roadway embankment.

e. Outlet Works: Robena Slurry Pond 6 does not have an outlet works facility because the impoundment zone is designed to fill with hydraulically placed coal waste materials.

f. Emergency Spillway:

(1) Approach Channel: On the date of inspection, the emergency spillway approach channel was clear of obstructions and debris that might reduce the spillway's capacity.

(2) Overflow Crest: The broad crested weir type overflow crest appeared to be functional and was unobstructed on the date of inspection. The width was measured to be approximately 10 feet instead of the 15 feet indicated by design drawings.

(3) Discharge Channel: The emergency spillway discharge channel is a riprap lined ditch that crosses the right abutment for approximately 2,300 feet before entering a natural drainway to Whiteley Creek. The riprap materials in the spillway lining are similar to those on the upstream slope of the embankment. On the date of inspection, no erosion of riprap or significant instability was observed anywhere along the length of the discharge channel.

A reservoir diversion channel discharges to the emergency spillway discharge channel immediately below the overflow crest. The diversion channel was sparsely vegetated and had suffered some erosion of slopes and base. Consequently, some sediment was observed immediately below the confluence with the spillway discharge channel. The amount of sediment, however, was not significant enough to affect spillway discharge flows.

g. Reservoir:

(1) Slopes: The slopes of the reservoir are moderately steep and, on the date of inspection, were entirely covered with a recently germinated covering of grass. Some minor erosion gullies were observed on the reservoir slopes but there was no sign of significant erosion or slope instability. The slopes appeared to be in an immediate post construction phase.

(2) Inlet Stream: There is no defined inlet stream to Robena Slurry Pond 6 because of the reservoir's location near a ridgeline.

(3) Sedimentation: No natural sedimentation observed.

(4) Watershed: The watershed contributing to Robena Slurry Pond 6 is entirely undeveloped and consists primarily of woodland in the upper reaches and grassland near the impoundment zone.

h. Instrumentation:

(1) Monumentation/Surveys: A bench mark bearing Elevation 1055.13 was observed on the right abutment near the emergency spillway. Water level measuring devices near the center of the crest of the dam including piezometers and observation wells which were at elevations of approximately 1061.

(2) Piezometers: Six piezometers of the pneumatic type were observed at three separate locations on the embankments crest and downstream slopes. The most recent water level readings were provided by the owner's representative.

(3) Observation Wells: Three observation wells were observed on the embankment's crest and downstream slopes at three separate elevations. The most recent water level readings were provided by the owner's representative.

(4) Settlement Indicators: The most recent readings for two settlement gauges and two settlement plates were provided by the owner's representative.

(5) Weirs: A sharp crested weir is located at the downstream end of the principal spillway outlet structure. The weir height and crest length were each measured to be three feet. On the date of inspection, a head of approximately six inches was observed flowing over the weir.

i. Downstream Conditions:

(1) Channel: The principal spillway downstream channel below Pond 6 flows through a riprap lined channel before entering Robena Slurry Pond 4 below.

Pond 4 discharges via a concrete lined open channel spillway to Whiteley Creek, approximately 7,500 feet above its confluence with the Monongahela River.

The emergency spillway discharge channel discharges directly to Whiteley Creek via a natural drainway.

(2) Floodplain Conditions: The only inhabited structure between Pond 6 and the Monongahela River is the Robena Mine Preparation Plant, which lies on the Whiteley Creek floodplain. In the event of a failure of Pond 6, Pond 4 would also most likely fail, resulting in possible loss of a few lives and significant damage to the industrial facility.

3.2 EVALUATION

The following evaluations are based on the results of the visual inspection performed on 20 May 1981:

a. Embankment: The condition of the Robena Slurry Pond 6 embankment was good. Only minor deficiencies were observed during the inspection. These included:

(1) Minor erosion and minor topsoil sloughing at various locations on the embankment's downstream slope;

(2) Minor erosion at and near embankment groins and;

(3) Two seeps of undetermined origin near the immediate downstream toe of the embankment.

b. Principal Spillway: The principal spillway appeared to be in good condition and functioning properly. No flow obstruction or structural deterioration was observed on any part of the principal spillway facility.

c. Emergency Spillway: The emergency spillway was in good condition on the date of inspection. No significant obstruction, erosion or instability of channel bottom or slopes was observed.

d. Hazard Potential: Based on the observed height of the dam and the downstream conditions, Robena Slurry Pond 6 was assigned a "significant" hazard potential rating.

SECTION 4 OPERATIONAL FEATURES

4.1 PROCEDURE

Reservoir pool level is maintained by the intake ports of the principal spillway. Normal operating procedure does not require a dam tender but periodic closure of intake ports is required to maintain an acceptable discharge water quality. The principal spillway is controlled by a butterfly type valve at the downstream toe of the embankment. Upstream control can be accomplished by closing the intake ports of the principal spillway.

The emergency spillway operates in an uncontrolled manner and does not require specific operator attention other than for routine maintenance.

4.2 MAINTENANCE OF DAM

The embankment and appurtenances are maintained by the United States Steel Corporation. Maintenance reportedly consists of periodically repairing eroded and sloughed areas and making miscellaneous repairs as necessary.

4.3 INSPECTION OF DAM

The United States Steel Corporation is required by the State of Pennsylvania to inspect the dam annually and make needed repairs.

The United States Steel Corporation is required by the Mining Safety and Health Administration (MSHA) to inspect the dam at least once every seven days and to make an annual report and certification of the dam.

4.4 WARNING PROCEDURE

There is no warning system and no formal emergency procedure to alert or evacuate downstream residents upon the threat of a dam failure.

4.5 EVALUATION

Principal spillway operating facilities are sufficient to provide adequate flow control.

The current dam maintenance program appears to be adequate and should be continued. However, there is no written operation, maintenance or inspection procedure, nor is there a warning system or formal emergency procedure for this dam. These procedures should be developed in the form of checklists and step by step instructions, and should be implemented as necessary.

SECTION 5 HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data: Robena Slurry Pond 6 has a watershed of 68 acres which is vegetated primarily by woodland and grassland. The watershed is about one half mile long and one quarter mile wide and has a maximum elevation of 1,320 feet (MSL).

The Pond is used to settle out the fine refuse from a coal preparation plant slurry; the normal pool elevation rises as the pond fills.

At the design emergency spillway crest elevation (1050), the pond has a surface area of 24 acres and a storage capacity of 619 acre-feet. The emergency spillway was designed as a riprap lined, trapezoidal open channel with a 15 foot base width and side slopes of 2H:1V. The emergency spillway is located on the right abutment.

Spillway capacity and embankment freeboard were made sufficient to accommodate 424 cubic feet per second, which was considered sufficient for this structure and watershed at the time of design.

According to PennDER files, a freeboard hydrograph was developed for 100% of a PMP of 25.8 inches in 6 hours. Reservoir routing of this storm through the 15 foot wide emergency spillway resulted in a maximum water surface elevation of 1053.72 feet. The above calculation was performed assuming an emergency spillway crest and maximum sediment elevation at 1050.0 and a top of dam elevation of 1055.0. No other hydrologic calculations were found relating reservoir/spillway performance to the Probable Maximum Flood (PMF) or fractions thereof.

b. Experience Data: Records are not kept of reservoir level or rainfall amounts. There is no record or report of the embankment ever being overtopped.

c. Visual Observations: On the date of the field inspection, no serious deficiencies were observed that would prevent the emergency spillway from functioning. The pool elevation, at the time of the inspection, was about 39 feet below the crest of the dam.

The emergency spillway invert elevation was measured to be 1051.1 (average of 1050.8 and 1051.4) instead of 1050.0 as indicated by design drawings. The base width was approximately 10 feet and side slopes were approximately 2H:1V on the left and 4H:1V on the right. The discrepancies from design conditions are attributed to measurement difficulties across the massive sandstone boulders that cover the spillway overflow crest.

For purposes of the HEC-1 analysis, the most conservative conditions were used.

d. Overtopping Potential: Overtopping potential was investigated through the development of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway. The Corps of Engineers guidelines recommend the Probable Maximum Flood (PMF) for "large" size, "significant" hazard dams. Based on the size and hazard classification, the Robena Slurry Pond 6 basin has a Spillway Design Flood (SDF) of the PMF.

Hydrometeorological Report No. 33 indicates the adjusted 24 hour Probable Maximum Precipitation (PMP) for the subject site is 19.4 inches. No calculations were available to indicate whether the reservoir and spillway (with noted discrepancies from design conditions) are sized to pass a flood corresponding to the runoff from 19.4 inches of rainfall in 24 hours. Consequently, an evaluation of the reservoir/spillway system was performed to determine whether or not the dam's spillway capacity is adequate under current Corps of Engineers guidelines.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July 1978. The major methodologies and key input data for this program are discussed briefly in Appendix D.

The reservoir pool level was assumed to be at Elevation 1051.1 at the beginning of routing of the SDF.

The peak inflow to Robena Slurry Pond 6 was determined by HEC-1 to be 363 cfs for a full PMF.

e. Spillway Adequacy: The capacity of the combined reservoir and emergency spillway system was determined to be in excess of 100% of the PMF by HEC-1. According to Corps of Engineers' guidelines, the combined reservoir spillway capacity of Robena Slurry Pond 6 is "adequate".

SECTION 6 STRUCTURAL STABILITY

6.1 AVAILABLE INFORMATION

a. Design and Construction Data: All available design documentation, calculations and other data received from the Pennsylvania Department of Environmental Resources and the United States Steel Corporation were reviewed. Embankment stability analyses were performed by L. Robert Kimball, Consulting Engineers, using results of a soils investigation. However, samples of the coarse refuse or rock toe materials were not available and the consultant assumed strength parameters for these materials.

The embankment was designed as a zoned structure with an impervious clay core and foundation cutoff to bedrock. A foundation grout curtain was also provided. The upstream shell was to be random fill with a riprap cover above Elevation 1010. The downstream shell was to be coarse coal refuse with topsoil cover. Downstream slopes were to range from 2.5H:1V to 2.75H:1V with two 20 foot wide benches at 40 foot vertical intervals.

The consultant reported the following results:

<u>Condition</u>	<u>Analysis Method</u>	<u>Loading</u>	<u>Lowest Safety Factor</u>
End of Construction Sta. 7+20 - Upstream	Bishop	Static	1.30
End of Construction Sta. 7+20 - Downstream	Bishop	Static	1.71
Steady Seepage Sta. 7+20 - Downstream	Bishop	Static	1.93
Steady Seepage Sta. 7+20 - Downstream	Fellenius	Earthquake	1.71
End of Construction Sta. 14+50 - Upstream	Bishop	Static	2.73
End of Construction Sta. 14+50 - Downstream	Bishop	Static	1.97
Steady Seepage Sta. 14+50 - Downstream	Bishop	Static	1.92

Inspection reports by state personnel during construction did not indicate significant changes from design conditions.

The application report by the Division of Dams and Encroachments cited the existence of possible undermining of a portion of the embankment but concluded that based on overburden depth and composition and an estimated coal extraction rate of only 30%, that mine subsidence was not expected to have an adverse effect on the safety of the embankment.

b. Operating Records: There are no written operating records or procedures for this dam.

c. Post-Construction Changes: There are no reported post construction modifications to this dam.

d. Mining Activity: The Pittsburgh Coal Seam lies approximately 240 feet below the dam and impoundment and some coal may have been removed by development mining. Company personnel indicated that the entries may have reached an area beneath the left flank of the dam but did not approach the impoundment zone. The overburden in the undermined area was estimated at 300 feet.

The Waynesburg Coal outcrops in the adjacent hillsides and has most likely been removed by surface mining techniques.

e. Visual Observations: The field inspection disclosed no evidence of potential instability of the embankment or foundation. The slopes showed no signs of anomolous movement.

No embankment seepage or marked vegetal changes indicating embankment seepage were observed during the field inspection.

No surface evidence of mine subsidence was observed during the field inspection.

f. Water Level Data: The most recent readings provided by the owner's representative for the piezometers and observations wells did not indicate unusually high water levels within the core or downstream slope. Based on the water level readings, the embankment internal drains appear to be functioning.

g. Performance: There has been no indication or report of any problems with the performance of the embankment over its one year life.

6.2 EVALUATION

a. Design Documents: The design documentation, by itself, was considered inadequate to evaluate the structures.

b. Embankment: Based on the results of the visual observations of embankment slopes, materials, and seepage conditions, the embankment is considered to have an adequate margin of safety against sliding.

c. Emergency Spillway: Based on results of the visual inspection, the emergency spillway structure for Pond 6 appears to be stable.

d. Seismic Stability: According to the Seismic Risk Map of the United States, Pond 6 is located in Zone 1 where damage due to earthquake would most likely be minor.

A dam located in Seismic Zone 1 may be assumed to present no hazard from an earthquake provided static stability conditions are satisfactory and conventional safety margins exist. The design engineers' calculations support this assumption.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS

7.1 ASSESSMENT

a. Evaluation:

(1) Embankment: Robena Slurry Pond 6's embankment is considered to be in good condition. This assessment is based on visual observations that revealed only very minor deficiencies.

(2) Principal Spillway: The condition of the principal spillway is considered to be good.

(3) Emergency Spillway: The condition of the visual observations and emergency spillway is considered to be good. This is based on an "adequate" capacity rating determined using the HEC-1 computer program. The emergency spillway was found to pass in excess of 100% of the Probable Maximum Flood. The Spillway Design Flood is the PMF because of the embankment's size and hazard classification.

b. Adequacy of Information: The information available on design, construction, operation and performance history in combination with visual observations and hydrologic and hydraulic calculations was sufficient to evaluate the embankment and appurtenant structures in accordance with the Phase I Investigation guidelines.

c. Urgency: The recommendations presented in Section 7.2a should be implemented immediately.

d. Necessity for Additional Data/Evaluation: None.

7.2 RECOMMENDATIONS

a. Emergency Operation and Warning Plan: Concurrent with the additional investigations recommended above, the owner should develop an Emergency Operation and Warning Plan including:

(1) Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

(2) Procedures for around the clock surveillance during periods of heavy precipitation or runoff.

(3) Procedures for drawdown of the reservoir under emergency conditions.

(4) Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

b. Maintenance and Inspection Procedures: The owner should develop written maintenance and inspection procedures in the form of checklists and step-by-step instructions.

c. Remedial Work. The Phase I investigation of Pond 6 disclosed very minor deficiencies which should be corrected during routine maintenance. This would include repair of minor sloughing and minor erosion of slopes on and adjacent to the embankment.

C

APPENDIX A
VISUAL INSPECTION CHECKLIST

VISUAL OBSERVATIONS CHECKLIST I
(NON-MASONRY IMPOUNDING STRUCTURE)

Name of Dam Robena Slurry Pond 6 County Greene State Pennsylvania National ID # PA 00197
 Type of Dam Zoned, earth and coarse coal refuse Hazard Category Significant
 Dates of Inspection 20 May 1981 Weather Clear, warm Temperature 65°F
 Pool Elevation at Time of Inspection 1016.0 (MSL)
 Tailwater at Time of Inspection 935.7 (MSL)

Inspection Personnel: J. E. Barrick, P.E. Ackenheil & Associates, Project Manager
 and Hydrologist
 J. P. Hannan Ackenheil & Associates, Geotechnical Engineer
 S. G. Mazzella Ackenheil & Associates, Civil Engineer
 J. D. Floris U. S. Steel Corporation, Owners Representative

Recorder J. E. Barrick

GEO Project G80138-B
 PennDER I.D. No. 30-26

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	<p>Two small slough zones were observed on the embankment's downstream slope. Both sloughs appeared to be the result of topsoil slippage.</p> <p>Numerous minor erosional gullies were observed on the embankments's downstream slope. The gullies were generally quite small and appeared to predate the germination of the existing slope vegetation.</p> <p>Numerous small erosional gullies were observed on the abutments hillsides, and slopes adjacent to the embankment. The gullies appeared to be the result of surface runoff on previously unvegetated post-construction slopes.</p> <p>No sloughing of abutment slopes was observed.</p>	

EMBANKMENT (CONTINUED)

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	<p>The embankment crest appeared to have the proper horizontal alignment, as indicated by construction drawings provided by the owner's representative. No offsets or abrupt changes in alignment were observed that would indicate anomalous movement of the embankment.</p> <p>The embankment crest appeared to be highest in the central portion of the dam and sloped gradually towards each abutment. A depression in the crest was observed at the point where two 8 inch diameter steel pipes passed over the crest to discharge slurry and acid mine drainage to the impoundment zone.</p>	
RIPRAP FAILURES	None observed.	
SETTLEMENT	See "Vertical and Horizontal Alignment of the Crest" above.	
JUNCTION OF EMBANKMENT AND ABUTMENT	The junction of the embankment and both abutments appeared to be in good condition. Considerable portions of both junctions were riprap lined. Small drainage channels were observed along other portions of the junctions and these were either in good condition or contained minor erosion.	
JUNCTION OF EMBANKMENT AND SPILLWAY	No seepage, erosion or indications of instability were observed anywhere along the junction of the embankment and the emergency spillway. The junction was entirely protected by boulder sized sandstone riprap.	

EMBANKMENT (CONTINUED)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	<p>Small amounts of water were observed to be draining from the slope at various locations. In most cases, the elevation of this drainage was at or above the observed pool level in the impoundment resulting from reported heavy rains the preceding day.</p> <p>A culvert pipe located below the toe of the embankment near the left end of the dam had a flow of approximately 1 to 2 gallons per minute.</p> <p>Two small seeps were emanating from beneath the riprap material at the immediate toe of the embankment. The flows were small, in the range of 1 to 2 gallons per minute, and some minor sedimentation was observed in the drainage channels. The source of the flows and sedimentation could not be determined.</p>	
STAFF GAGE AND RECORDER	None observed.	
DRAINS	None observed.	
SURFICIAL CONDITIONS	<p>The embankment crest was covered with gravel sized sandstone fragments for its entire length and width. The depth of the covering ranged from 1 to 1.5 feet. The covering was generally uniform and contained no vegetal growth or significant depressions. A steel guardrail was located along the junction of the crest and the embankment's downstream slope.</p>	

EMBANKMENT (CONTINUED)

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
<u>SURFICIAL CONDITIONS</u> <u>(CONTINUED)</u>	<p>The embankment's upstream slope was covered with a uniform blanket of sandstone riprap. The slope was generally uniform from top to bottom and abutment to abutment and showed no signs of slope distress or riprap erosion. The riprap materials were angular sandstone fragments ranging in size from gravel through 36 inches.</p> <p>The embankment's downstream slope consisted of three slope sections separated by two benches. The slopes were generally vegetated with recently germinated grasses and contained some minor erosional gullies and minor slough zones. The slopes were generally uniform from top to bottom and abutment to abutment and showed no indications of significant settlement, seepage or instability. The toe of the downstream slope was covered with sandstone riprap.</p>	

PRINCIPAL SPILLWAY

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
INTAKE STRUCTURE	<p>The principal spillway intake structure was in good physical condition. The inlet ports were not rusted and were operational on the date of inspection.</p> <p>The trash cage on the lowest inlet port was free and clear of debris.</p>	
CONTROL STRUCTURE	<p>The principal spillway control structure was in good condition. No significant cracks or deterioration of concrete walls was observed and steel components were painted and appeared to be well maintained.</p> <p>Some dampness was observed on the base slab of the control structure, at an elevation well below the surrounding ground surface.</p> <p>The control structure contained an 20 inch diameter (nominal) steel pipe with butterfly type valve. The valve control was not activated but appeared to be in good condition.</p>	
CONDUIT	<p>The only visible portion of the principal spillway conduit was at the control structure. The conduit appeared to be in good condition.</p>	
OUTLET STRUCTURE	<p>The principal spillway outlet structure appeared to be in good condition. No significant cracking of concrete walls and slabs was observed and the flow channel over weirs and end walls was clear and unobstructed.</p>	

PRINCIPAL SPILLWAY (CONTINUED)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
DISCHARGE CHANNEL	The principal spillway discharge channel, immediately below the outlet structure, was lined with sandstone riprap for a distance of approximately 50 feet where it entered a six foot diameter concrete pipe culvert beneath the dam's access roadway. The riprap, culvert wingwalls and exposed portions of the pipe were in good condition on the date of inspection.	
EMERGENCY GATE	None observed.	

EMERGENCY SPILLWAY

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
APPROACH CHANNEL	The emergency spillway approach channel was clear of obstructions that would reduce its flow capacity.	
OVERFLOW SECTION	The emergency spillway overflow section occurs approximately five feet below the crest of the embankment where there is a relatively flat area in the channel bottom. No obstructions that would reduce the spillway capacity were observed.	
DISCHARGE CHANNEL	<p>The emergency spillway discharge facility is an open channel across the right abutment that is riprap lined for a considerable distance below the overflow crest. The riprap lining in the channel appeared to be in good condition and no indications of significant erosion or instability were observed.</p> <p>A fence crosses the discharge channel approximately 400 feet below the overflow crest. Posts containing barb wire extend from below the fence to the bottom of the channel, presenting a minor obstruction to flows in the channel. The obstruction, however, would not affect discharge through the spillway channel's overflow section.</p> <p>A watershed diversion channel enters the discharge channel immediately below the overflow section. The diversion channel slopes are partially vegetated and some erosion has occurred with resultant sedimentation at the confluence with the discharge channel. The condition does not affect the capacity of the spillway to discharge design flows.</p>	

INSTRUMENTATION

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
MONUMENTATION SURVEYS	<p>A bench mark, with indicated Elevation 1055, was observed on the right abutment adjacent to the emergency spillway channel.</p> <p>Several piezometers and observation wells located near the crest of the embankment contained indicated elevations of approximately 1061.</p>	
WEIRS	<p>A flow measuring weir is located at the downstream end of the principal spillway outlet structure below the dam. The weir consists of a steel plate three feet high and three feet wide located between the concrete walls of the outlet structure. On the date of inspection, the water depth approximately three feet upstream of the weir was approximately 3.5 feet.</p> <p>No obstructions were observed in the flow channel but some corrosion and deposition of yellow boy materials was observed on the steel plate weir.</p>	
PIEZOMETERS	<p>Six piezometers of the pneumatic type were observed at various locations on the embankment's crest and downstream slope. The owner's representative provided a copy of the most recent piezometer readings for inclusion in the report (see Page A11).</p>	

INSTRUMENTATION (CONTINUED)

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
OBSERVATION WELLS	Three observation wells were observed at three levels on the embankment's crest and downstream slope. The owner's representative provided a copy of the most recent water level readings for inclusion in the report (see Page A11).	
SETTLEMENT INDICATORS	Two settlement gauges were observed on the embankment's crest and downstream slope. A copy of the most recent readings were provided for inclusion in the report (see Page A11). The most recent readings for two settlement plates in the embankment were also provided by the owner's representative (page A11).	

INSTRUMENTATION (CONTINUED)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
OBSERVATION WELLS	Three observation wells were observed at three levels on the embankment's crest and downstream slope. The owner's representative provided a copy of the most recent water level readings for inclusion in the report (see Page A11).	
SETTLEMENT INDICATORS	Two settlement gauges were observed on the embankment's crest and downstream slope. A copy of the most recent readings were provided for inclusion in the report (see Page A11). The most recent readings for two settlement plates in the embankment were also provided by the owner's representative (page A11).	

DAILY READINGS OF DAM MONITORS

REFUSE SETTLING BASIN U.S. ROBERTA MINE

DATE: 3-10-81

SPEC 193-6238-1

	BOTT. ELEV.	TOP ELEV.	PORE PRESS.	BOTT. ELEV.	TOP ELEV.	DIFF.	TOP WATER ELEV.	BOTT. ELEV.	TOP ELEV.	BOTT. ELEV.	TOP ELEV.
P-1	9480	10231	200								
P-2	9150	10231	11.5								
P-3	10020	10231	5								
P-4	9450	10200	5.5								
P-5	9700	10200	5								
P-6	9410	9800	2.0								
PNEUMATIC PIEZOMETER											
				0-1	9430	10231	11.2	9959			
				0-2	9450	10200	64.4	9550			
				0-3	9410	9802	33.7	945.5			
SETTLEMENT GAUGE											
									SG-1	9450	10231
									SG-2	9400	1020.0
SETTLEMENT RATE											
										SR-1	9520
										SR-2	9490

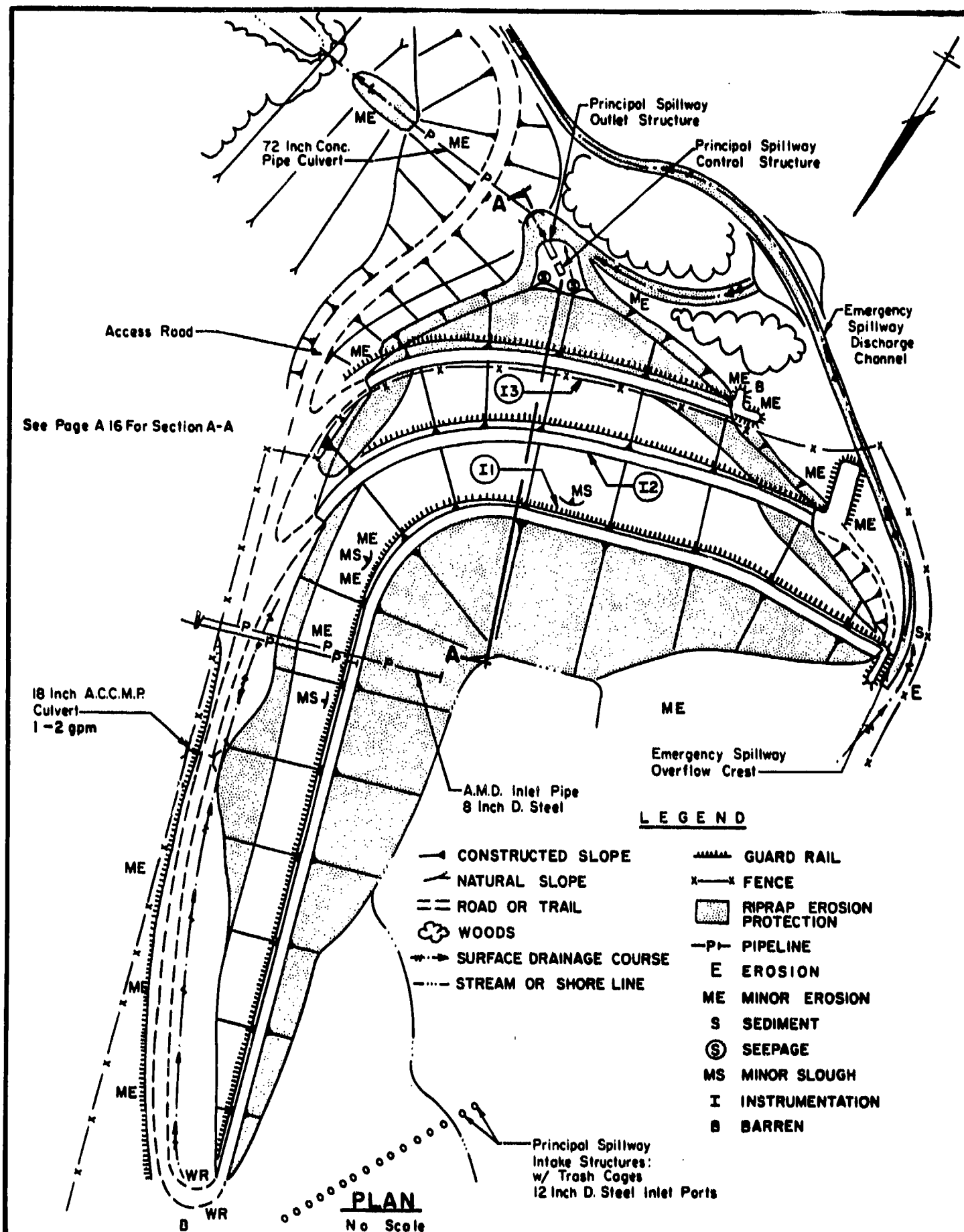
102097

RESERVOIR

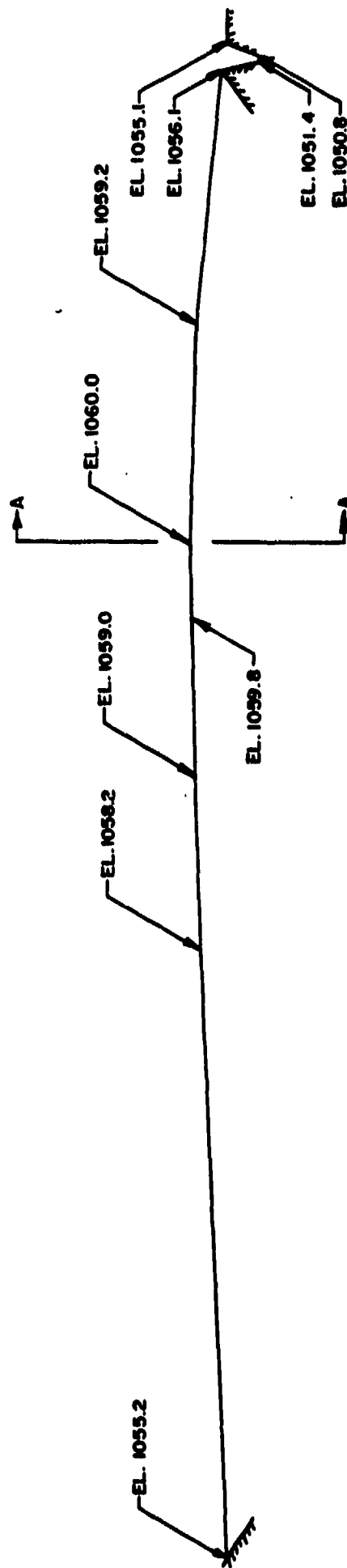
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The slopes of the reservoir were moderately steep and clear of all brush and trees. The slopes contained a recently germinated stand of grass and some minor erosion gullies. No significant erosion or slope instability was observed within or adjacent to the impoundment zone.	
SEDIMENTATION	No natural sedimentation was observed. Some acid mine drainage sediment (yellow boy) was observed in the reservoir immediately below the discharge point of the yellow boy pipeline.	
INLET STREAM	Because of the reservoir's location high in the watershed, there is no defined inlet stream.	
WATERSHED	On the date of inspection, the watershed was completely undeveloped. The watershed was wooded in the upper reaches and grassed in the immediate vicinity of the impoundment.	

DOWNSTREAM CONDITIONS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	<p>The principal spillway discharge channel, below the access road embankment and culvert, flows through a riprap lined channel for a short distance before entering the impoundment zone of an older slurry disposal impoundment below.</p> <p>The discharge channel for the emergency spillway discharges to Whiteley Creek via a natural drainway.</p> <p>The older facility discharges via a concrete lined spillway channel to Whiteley Creek, approximately 7,500 feet above the point of confluence with the Monongahela River.</p>	
APPROXIMATE NUMBER OF HOMES AND POPULATION	<p>The Robena Mine and Coal Preparation Plant is the only inhabited facility on the floodplain of Whiteley Creek between Robena Slurry Pond 6 and the Monongahela River.</p> <p>Visual observation indicates that catastrophic failure of Pond 6 would probably precipitate a similar catastrophic failure in the larger, older slurry disposal impoundment below. This multiple failure could result in loss of a few lives and significant damage and disruption of industrial facilities at the preparation plant below.</p>	



DATE: JULY 1981		ROBENA SLURRY POND 6 NATIONAL DAM INSPECTION PROGRAM		FIELD SKETCH
SCALE: NONE				
DR: JF	CK: JEB	A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.		
DWG. NO. 80138B-1				



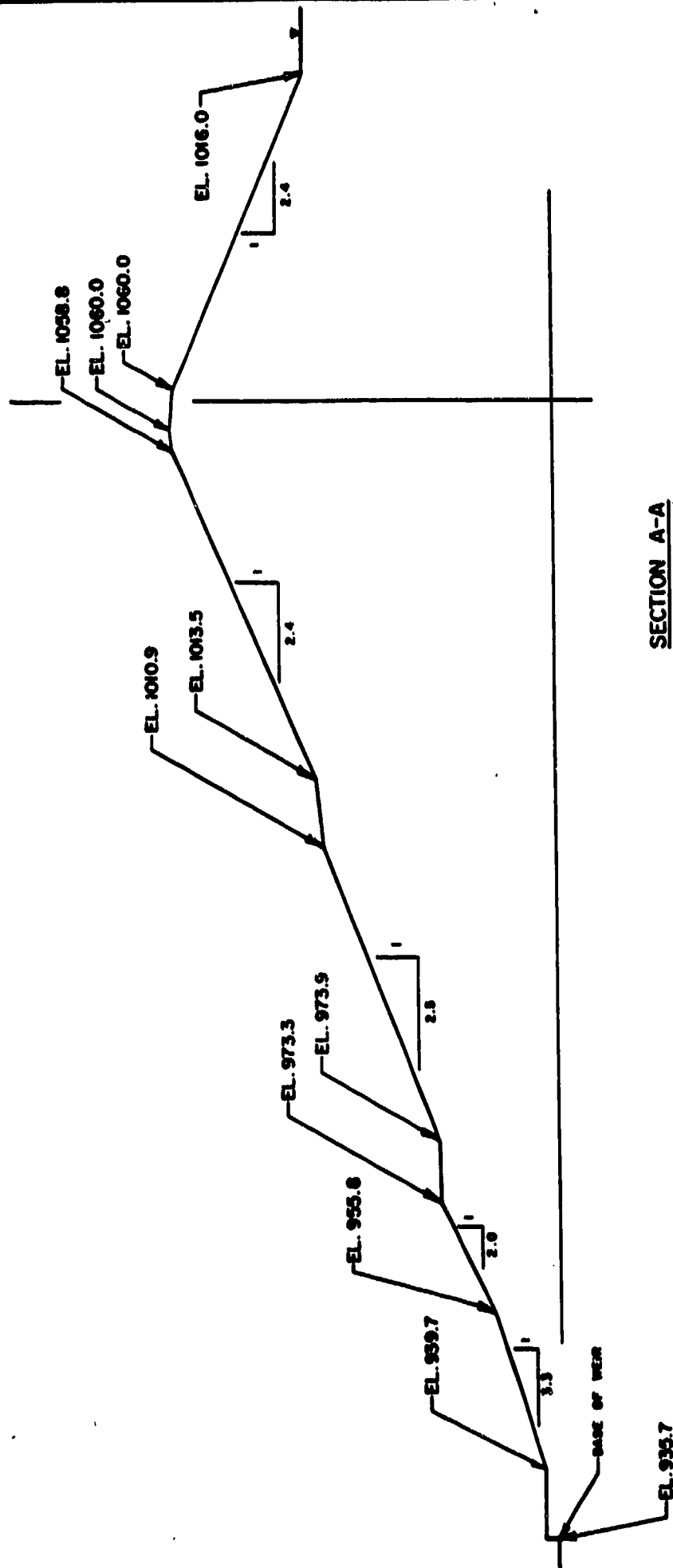
EL. 1016.0

EMBANKMENT PROFILE
(LOOKING DOWNSTREAM)
SCALE:
HORIZ. 1" = 200'
VERT. 1" = 20'

DATE: JULY 1981
SCALE: AS SHOWN
DR: JF CK: JEB
DWG. NO. 801388-3

ROBENA SLURRY POND 6 NATIONAL DAM INSPECTION PROGRAM
ACKENHEIL & ASSOCIATES CONSULTING GEO SYSTEMS, INC. ENGINEERS 1000 BANKSVILLE RD./PITTSBURGH, PA. 15216

FIELD PROFILE



See Page A14 For Section A-A Location

DATE: JULY 1981		ROBENA SLURRY POND 6		FIELD SECTION
SCALE: AS SHOWN		NATIONAL DAM INSPECTION PROGRAM		
DR: JF	CK: JEB	ACKENHEIL & ASSOCIATES CONSULTING		
DWG. NO. 801388-2		GEO SYSTEMS, INC. ENGINEERS		
		1000 BANKSVILLE RD./PITTSBURGH, PA. 15216		

APPENDIX B
ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Robena Slurry Pond 6
I.D. No. PA 00197

ITEM	REMARKS
Design Drawings	<p>Drawings by L. Robert Kimball, Consulting Engineers, Ebensburg, Pennsylvania for Robena Slurry Impoundment; Foreign Drawing 026, including:</p> <p>Sheet 1 of 51; Contour Grading Plan* Sheet 5 of 51; Access Road, Decant Pipe and Monitor Location Sheet 8 of 51; Spillway and Channel Details*** Sheet 36 of 51; Cross Section at Sta. 6+50, 7+00 and 7+50***</p>
As-Built Drawings	None available.
Regional Vicinity Map	USGS 7-1/2 Minute Masantown Pennsylvania Quadrangle Map.
*Construction History	<p>Constructed by C. J. Langenfelter & Sons of Baltimore, Maryland. The dam was completed in September 1980.</p> <p>See progress reports by Regional Hydraulic Engineer dated 8 June 1978, 20 January 1980, 23 April 1980, 17 June 1980. Also progress report by Penndel personnel on 15 September 1980.</p>

ITEM	REMARKS
*Construction History (Continued)	See construction progress reports by Robert Witt, Jr., Chief Engineer, U.S.S. dated from 1 February 1980 through 3 October 1980. Dam completion letter dated 18 September 1980.
**Typical Sections of Dam	See Design Drawings.
**Outlets--Plans Details Constraints Discharge Ratings	See Design Drawings.
Rainfall/Reservoir Records	None available.
*Design Reports	See "Report Upon the Application of the United States Steel Corporation", dated 16 March 1978 prepared by the Chief, Dams Safety Section, Division of Dams and Encroachments, Pennsylvania Department of Environmental Resources. See "Engineering Report for Robena Fine Coal Refuse Settling Impoundment" prepared by L. Robert Kimball, Consulting Engineers, Ebensburg, Pennsylvania; undated. See review by District Conservationist Karl M. Niederwerfer for the Greene County Conservation District, U. S. Department of Agriculture, Soil Conservation Service, dated 17 August 1977.

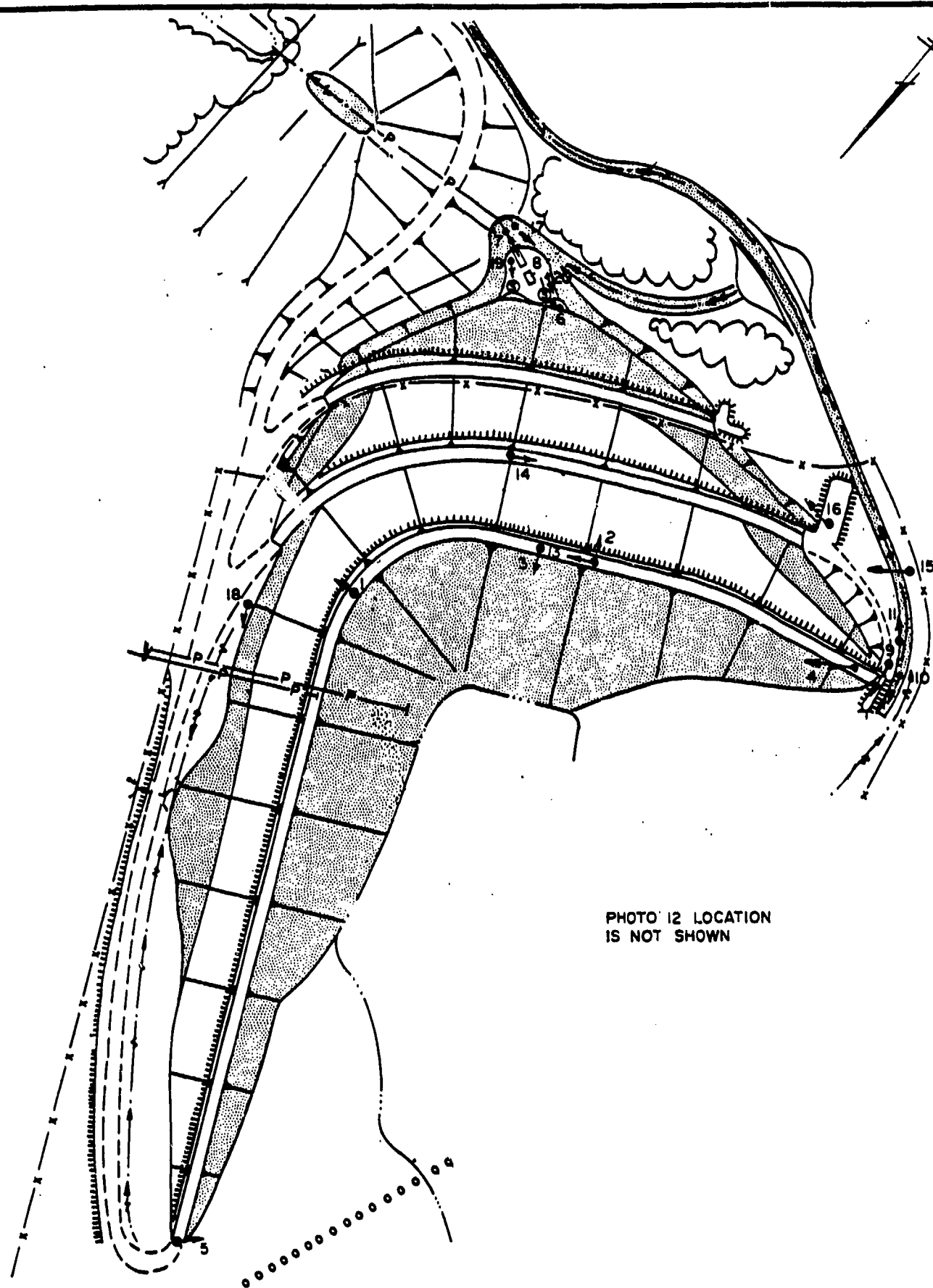
ITEM	REMARKS
*Geology Reports	See Design Reports above.
*Design Computations	See Design Reports above.
*Hydrology and Hydraulics	See Design Reports above.
*Dam Stability	See Design Reports above.
*Seepage Studies	See Design Reports above.
*Materials Investigation, Boring Records, Laboratory, Field	See Design Reports above.
Post-Construction Surveys of Dam	None recorded.
Borrow Sources	Information not available.
**Monitoring Systems	See Design Reports and Design Drawings above.
Modifications	None reported.

ITEM	REMARKS
High Pool Records	None available.
Post-Construction Engineering Studies and Reports	None available.
Maintenance/Operation Records	None available.
**Spillway-Plan Sections Details	See Design Drawings above.
**Operating Equipment Plans and Details	See Design Drawings above.
*Specifications	See "Construction Specifications for Robena Fine Coal Refuse Settling Impoundment" prepared by L. Robert Kimball, Consulting Engineers, Ebensburg, Pennsylvania.
*Miscellaneous	Miscellaneous correspondence involving applications, requirements and approval conditions including: "Dams and Encroachment Permit Application", dated 8 December 1976.

ITEM	REMARKS
*Miscellaneous (continued)	<p>"Review of Permit Application with Objections", by Mr. Gary Deiger, Waterways Patrolman, Pennsylvania Fish Commission, dated 14 February 1977. The fish commission objections were removed 23 January 1978 after consultation with U. S. Steel.</p> <p>Permit "to construct and maintain a dam across an unnamed tributary to Whiteley Creek," dated 24 April 1978.</p>
Prior Accidents or Failure of Dam Description Reports	<p>None available.</p>
* Information and data may be obtained from the PennDER, Harrisburg, Pennsylvania.	
** Obtained from United States Steel Corporation.	
***Reduced size reproductions contained in Appendix E.	

APPENDIX C

PHOTOGRAPHS



DATE: JULY 1981

SCALE: NONE

DR: JF CK: JEB

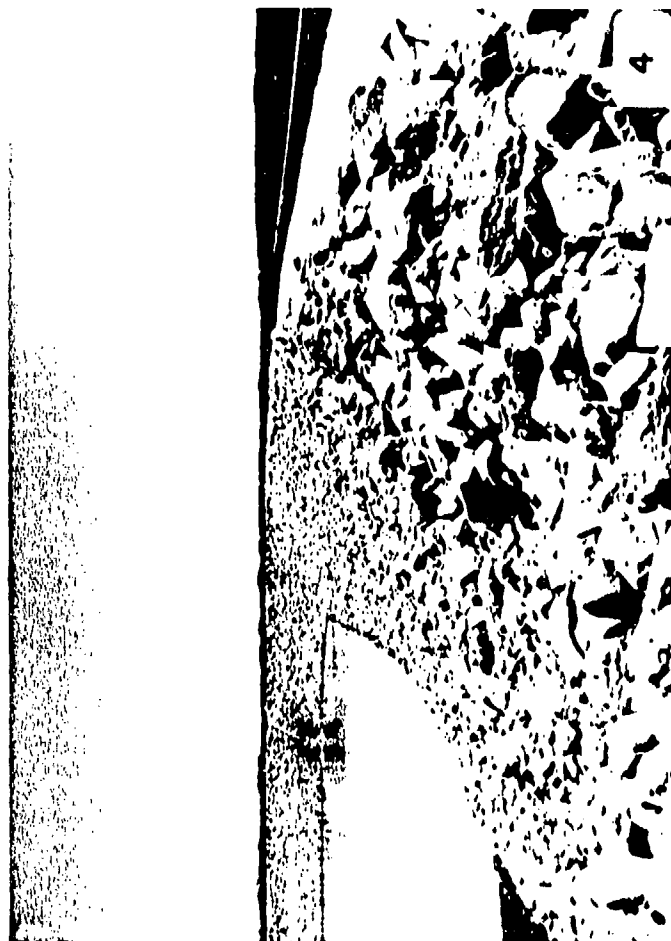
DWG. NO. 80138 B

ROBENA SLURRY POND 6
NATIONAL DAM INSPECTION PROGRAM

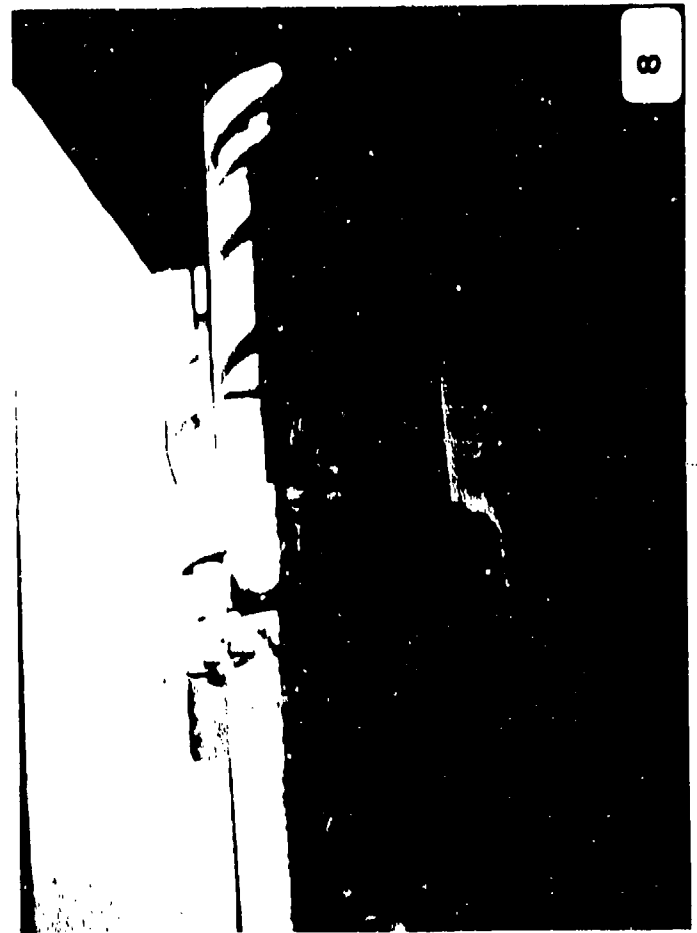
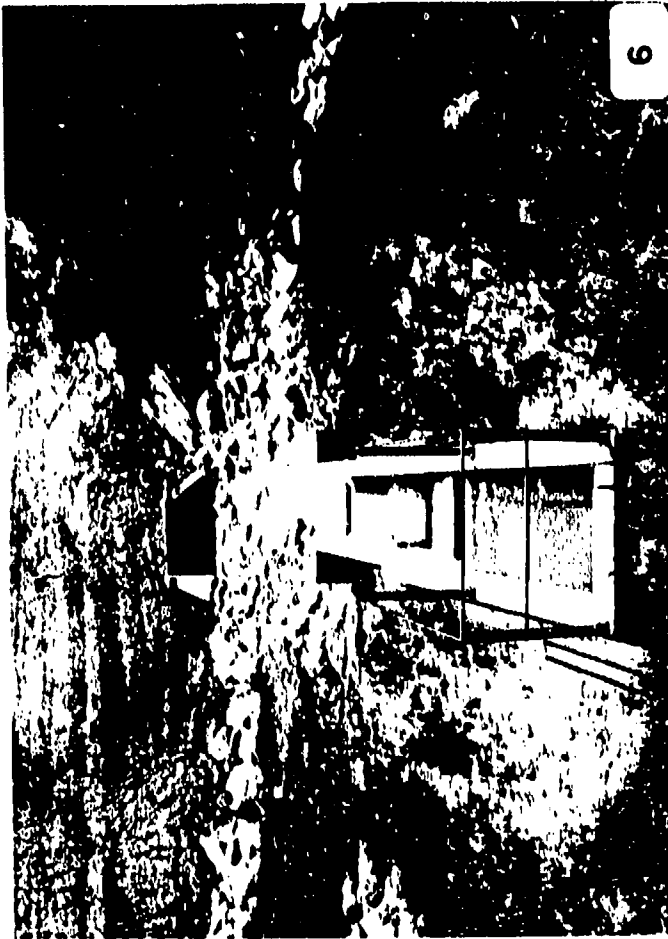
A. C. ACKENHEIL & ASSOCIATES, INC.
CONSULTING ENGINEERS
PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.

PHOTO KEY MAP

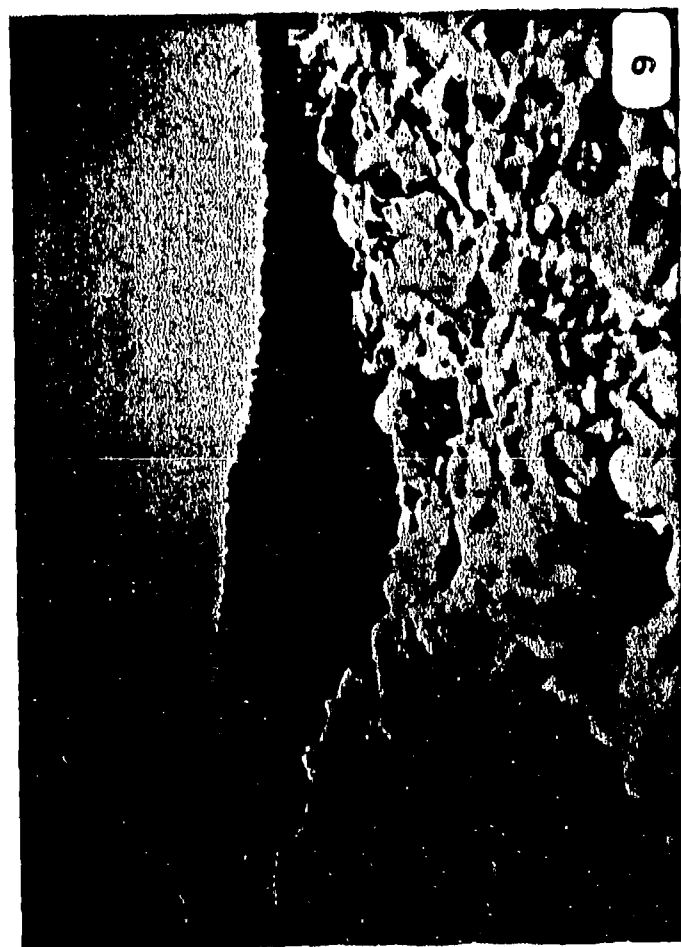
ROBENA SLURRY POND 6



ROBENA SLURRY POND 6



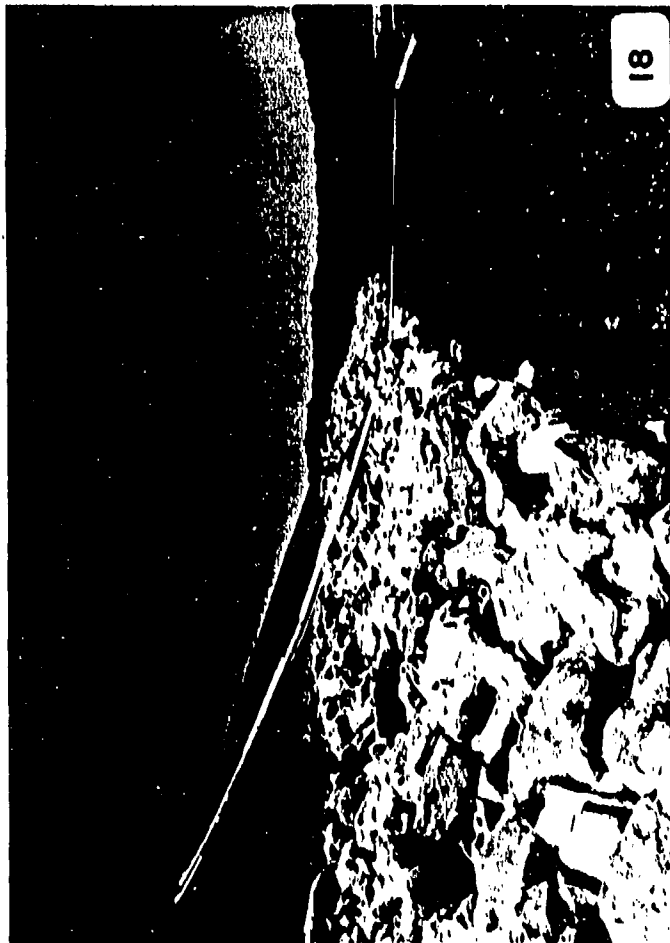
ROBENA SLURRY POND 6



ROBENA SLURRY POND 6



ROBENA SLURRY POND 6



PHOTOGRAPH DESCRIPTIONS

- Photo 1 Downstream Overview from embankment crest showing yellow boy pond, Slurry Pond 4, and Robena preparation plant.
- Photo 2 Embankment Toe Overview showing access road embankment and culvert, principal spillway outlet, and downstream slope benches.
- Photo 3 Reservoir Overview from crest.
- Photo 4 Overview of Upstream Slope.
- Photo 5 Principal Spillway Intake Structures.
- Photo 6 Principal Spillway Outlet Structure with flow baffles and weir.
- Photo 7 Overview of Toe Area showing outlet structure, toe, and right groin riprap.
- Photo 8 Principal Spillway Conduit in Control Structure.
- Photo 9 Emergency Spillway Overflow Crest.
- Photo 10 Diversion Ditch at right of Emergency Spillway.
- Photo 11 Emergency Spillway Discharge Channel.
- Photo 12 Site Overview with Slurry Pond 4 downstream.
- Photo 13 Embankment Crest and Instrumentation.
- Photo 14 Downstream Bench showing instrumentation and emergency spillway discharge channel in background.
- Photo 15 Downstream Slope.
- Photo 16 Right Groin, looking downstream.
- Photo 17 Toe and right groin, looking upstream.
- Photo 18 Left groin showing slurry and yellow boy inflow pipes.
- Photo 19 Seep, near left groin.
- Photo 20 Seep, near right groin.

APPENDIX D
HYDROLOGY AND HYDRAULICS
ANALYSES

APPENDIX D HYDROLOGY AND HYDRAULICS

Methodology: The dam overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version), July, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation: The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 33" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph: The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters, their definition and how they were obtained for these analyses.

<u>Parameter</u>	<u>Definition</u>	<u>Where Obtained</u>
Ct	Coefficient representing variations of watershed	From Corps of Engineers
L'	Length from centroid of watershed to spillway	From USGS 7.5 minute topographic map
Cp	Peaking coefficient	From Corps of Engineers
A	Watershed size	From USGS 7.5 minute topographic map

3. Routing: Reservoir routing is accomplished by using Modified Puls routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation-discharge relationship.

Storage in the pool area is defined by an area-elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or USGS 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping: Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Predominately woodland,
and grassland. No development.

ELEVATION TOP NORMAL POOL
(STORAGE CAPACITY): 1051.1 (646 acre-feet).

ELEVATION TOP FLOOD CONTROL POOL
(STORAGE CAPACITY): 1055.2 (753 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: 1055.0

ELEVATION TOP DAM: 1055.2 (minimum)

OVERFLOW SECTION

- a. Elevation 1051.1 (average)
- b. Type Trapezoidal Earth Open Channel-Riprap lined.
- c. Width 10 feet
- d. Length 20 feet
- e. Location Spillover Right abutment
- f. Number and Type of Gates None
- g. Side Slopes 2H:1V and 4H:1V (Assumed rectangular)

OUTLET WORKS

- a. Type Steel conduit with drop inlets
- b. Location East side of pond
- c. Entrance Inverts Varies with depth of sediment
- d. Exit Invert 935±
- e. Emergency Drawdown Facilities None

HYDROMETEOROLOGICAL GAGES

- a. Type None
- b. Location N/A
- c. Records None

MAXIMUM REPORTED NON-DAMAGING
DISCHARGE None reported

HEC-1 DAM SAFETY VERSION
HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Robena Slurry Pond 6	NDI ID NO. PA 00197
Probable Maximum Precipitation (PMP)	24.2*
Drainage Area	0.10 sq. mi.
Reduction of PMP Rainfall for Data Fit Reduce by 20%, therefore PMP rainfall	0.8 (24.2) =19.4 in.
Adjustments of PMF for Drainage Area (Zone 7)	
6 hrs.	102%
12 hrs.	120%
24 hrs.	130%
48 hrs.	140%
Snyder Unit Hydrograph Parameters	
Zone	29**
C _p	0.5
C _t	1.6
L'	0.28 mile
t _p = C _t (L') ^{0.6}	0.75 hour
Loss Rates	
Initial Loss	1.0 inch
Constant Loss Rate	0.05 inch/hour
Base Flow Generation Parameters	
Flow at Start of Storm	1.5 cfs/sq.mi=0.15 cfs
Base Flow Cutoff	0.05 x Q peak
Recession Ratio	2.0
Overflow Section Data	
Crest Width	10 feet
Channel Slope	3%
Side Slopes 2H:1V and 4H:1V	Assumed rectangular
Discharge Coefficient	3.09
Exponent	1.5
Discharge Capacity	257 cfs
Freeboard Above Overflow Crest	4.1 feet

* Hydrometeorological Report 33

** Hydrological zone defined by Corps of Engineers,
Baltimore District, for determining Snyder's Coefficients
(C_p and C_t).

ACKENHEIL & ASSOCIATES
GEO Systems, Inc.
1000 Banksville Road
PITTSBURGH, PA. 15216
(412) 531-7111

Job ROBENA Slurry Pond 6

Job No. 00138 B

Subject DATA Input

Made By JPH Date 5/15/81 Checked JEB Date 6/16/81

LOSS RATE AND BASE FLOW Parameters

STRTL = 1 INCH
CNSTL = 0.05"/hr
STRTQ = 1.5 cfs/mi²
QRCN = 0.05 (5% of Peak Flow)
RTIOR = 2.0

ELEVATION- AREA - Capacity RELATIONSHIPS

From "ENGINEERING REPORT ..."

AT ELEVATION 1050.0 AREA = 24 ACRES Storage = 619 Acre-ft.

AT ELEVATION 1065 AREA = 33 ACRES

From CONE method of Reservoir Volume, Flood Hydrograph Package
(HEC-1) Dam Safety Version (User's manual)

$$H = 3\sqrt{A} = 3\sqrt{\frac{619}{24}} = 77.4 \text{ feet}$$

Elevation where area equals zero

$$1050 - 77.4 = 972.6$$

\$ A	0	24.0	27.5	33.0
\$ E	972.6	1050.0	1055.0	1065.0

Overtop Parameters

Top of Dam Elevation

1055.2

Length of Dam (excluding Spillway)

1985 feet

Coefficient of Discharge

3.09

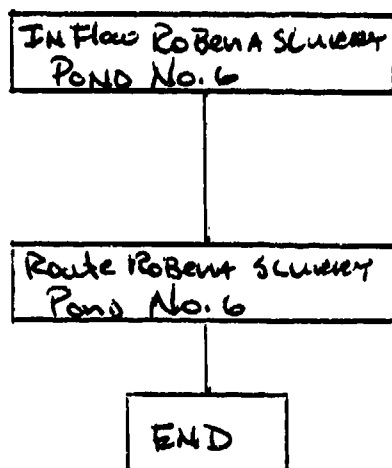
ACKENHEIL & ASSOCIATES
GEO Systems, Inc.
1000 Banksville Road
PITTSBURGH, PA. 15216
(412) 531-7111

Job ROBENA Sluery Pond 6 Job No. 80138B
Subject DATA Input
Made By JPH Date 5/15/81 Checked JEB Date 6/18/81

Spillway Parameters

Crest Elevation	1051.1 (AVERAGE)
Crest Width	10.0 feet
Side Slopes	Assumed rectangular
Coefficient of Discharge	3.09

Program Schedule



 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

1	A1	NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS									
2	A2	HYDROLOGIC AND HYDRAULIC ANALYSIS OF ROBENA SLURRY POND NO. 6									
3	A3	PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD									
4	B	300	0	10	0	0	0	0	0	-4	0
5	B1	5									
6	J	1	2	1							
7	J1	1.	.5								
8	K	0	1					1			
9	K1	INFLOW HYDROGRAPH FOR ROBENA SLURRY POND 6									
10	M	1	1	0.1	0.1					1	
11	P		-24.2	102	120	130	140				
12	T							1.0	.05		
13	W	0.75	0.50								
14	X	-1.5	-0.05	2.0							
15	K	1	2					1			
16	K1	ROUTING AT ROBENA SLURRY POND 6									
17	Y			1	1						
18	Y1	1						-1051.1			
19	\$A	0.	24.	27.5	33.0						
20	\$E	972.6	1050.0	1055.0	1065.0						
21	\$S	1051.1	10.0	3.09	1.5						
22	\$D	1055.2	3.09	1.5	1985.0						
23	K	99									
24	A										
25	A										
26	A										
27	A										
28	A										

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
END OF NETWORK	

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

RUN DATE: 17 JUN 81
 RUN TIME: 11.36.43

NATIONAL PROGRAM FOR THE INSPECTION OF NON FEDERAL DAMS
 HYDROLOGIC AND HYDRAULIC ANALYSIS OF ROBENA SLURRY POND NO. 6
 PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDER'S METHOD

JOB SPECIFICATION									
NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	10	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NRTIO= 2 LRTIO= 1

RTIOS= 1.00 0.50

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH FOR ROBENA SLURRY POND 6

ISTAQ 1 ICOMP 0 IECON 0 ITAPE 0 JPLT 0 JPRT 0 INAME 1 ISTAGE 0 IAUTO 0

HYDROGRAPH DATA

IHYD 1 IUHG 1 TAREA 0.10 SNAP 0.0 TRSDA 0.10 TRSPC 0.0 RATIO 0.0 ISNOW 0 ISAME 1 LOCAL 0

PRECIP DATA

SPFE 0.0 PMS 24.20 R6 102.00 R12 120.00 R24 130.00 R48 140.00 R72 0.0 R96 0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.807

LOSS DATA

LROPT 0 STRKR 0.0 DTKR 0.0 RTIOL 1.00 ERAIN 0.0 STRKS 0.0 RTIOK 1.00 STRTL 1.00 CNSTL 0.05 ALSMX 0.0 RTIMP 0.0

UNIT HYDROGRAPH DATA

TP= 0.75 CP=0.50 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH 35 END-OF-PERIOD ORDINATES, LAG= 0.76 HOURS, CP= 0.50 VOL= 1.00

4.	14.	28.	39.	43.	39.	33.	28.	24.	20.
17.	15.	13.	11.	9.	8.	7.	6.	5.	4.
3.	3.	2.	2.	2.	1.	1.	1.	1.	1.
1.	1.	0.	0.	0.	0.				

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
										SUM	27.10	24.68	2.42
										(688.)	(627.)	(61.)	(269.86)

HYDROGRAPH ROUTING

ROUTING AT ROBENA SLURRY POND 6

ISTAQ 2 ICOMP 1 IECON 0 ITAPE 0 JPLT 0 JPRT 0 INAME 1 ISTAGE 0 IAUTO 0

ROUTING DATA

QLOSS 0.0 CLOSS 0.0 AVG 0.0 IRES 1 ISAME 1 IOPT 0 IPMP 0 LSTR 0

NSTPS 1 NSTDL 0 LAG 0 AMSKK 0.0 X 0.0 TSK 0.0 STORA -1051. ISPRAT 0

SURFACE AREA= 0. 24. 28. 33.
CAPACITY= 0. 619. 748. 1050.
ELEVATION= 973. 1050. 1055. 1065.

CREL 1051.1 SPWID 10.0 COQW 3.1 EXPW 1.5 ELEV 0.0 COQL 0.0 CAREA 0.0 EXPL 0.0

DAM DATA

TOPEL 1055.2 COQD 3.1 EXPD 1.5 DAMWID 1985.

PEAK OUTFLOW IS 147. AT TIME 42.67 HOURS
PEAK OUTFLOW IS 62. AT TIME 42.83 HOURS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

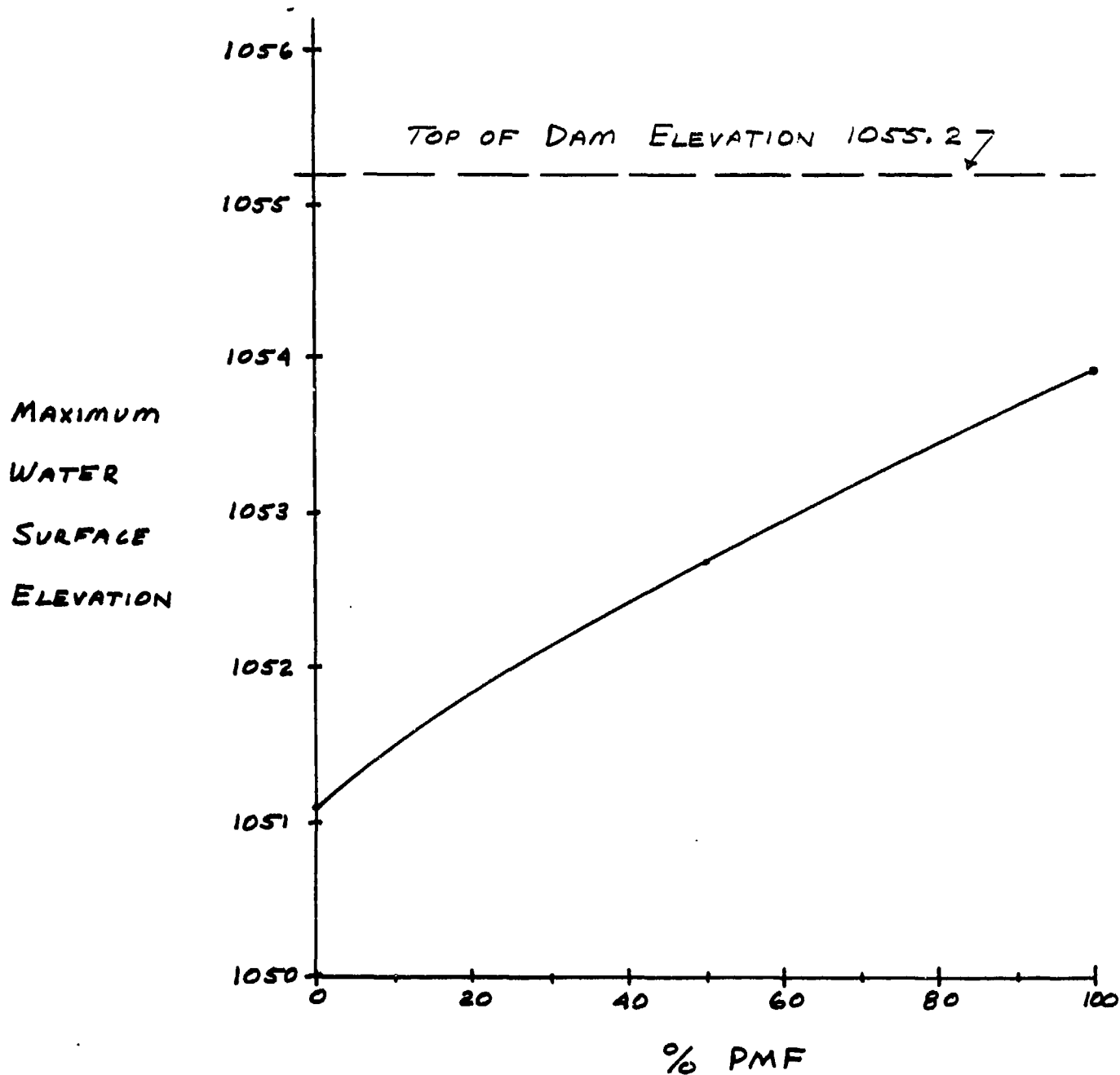
OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS	
				RATIO 1 1.00	RATIO 2 0.50
HYDROGRAPH AT	1	0.10	1	363.	181.
	(0.26)	(10.28)(5.14)(
ROUTED TO	2	0.10	1	147.	62.
	(0.26)	(4.17)(1.77)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	ELEVATION		INITIAL VALUE		SPILLWAY CREST		TOP OF DAM	
	STORAGE		1051.10		1051.10		1055.20	
	OUTFLOW		646.		646.		753.	
			0.		0.		257.	
	RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
	1.00	1053.93	0.0	719.	147.	0.0	42.67	0.0
	0.50	1052.70	0.0	686.	62.	0.0	42.83	0.0

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Job ROBENA SLURRY POND 6 Job No. 80138-B
Subject HYDROLOGIC PERFORMANCE PLOT
Made By SGM Date 17 JUNE 81 Checked JEB Date 6/18/81

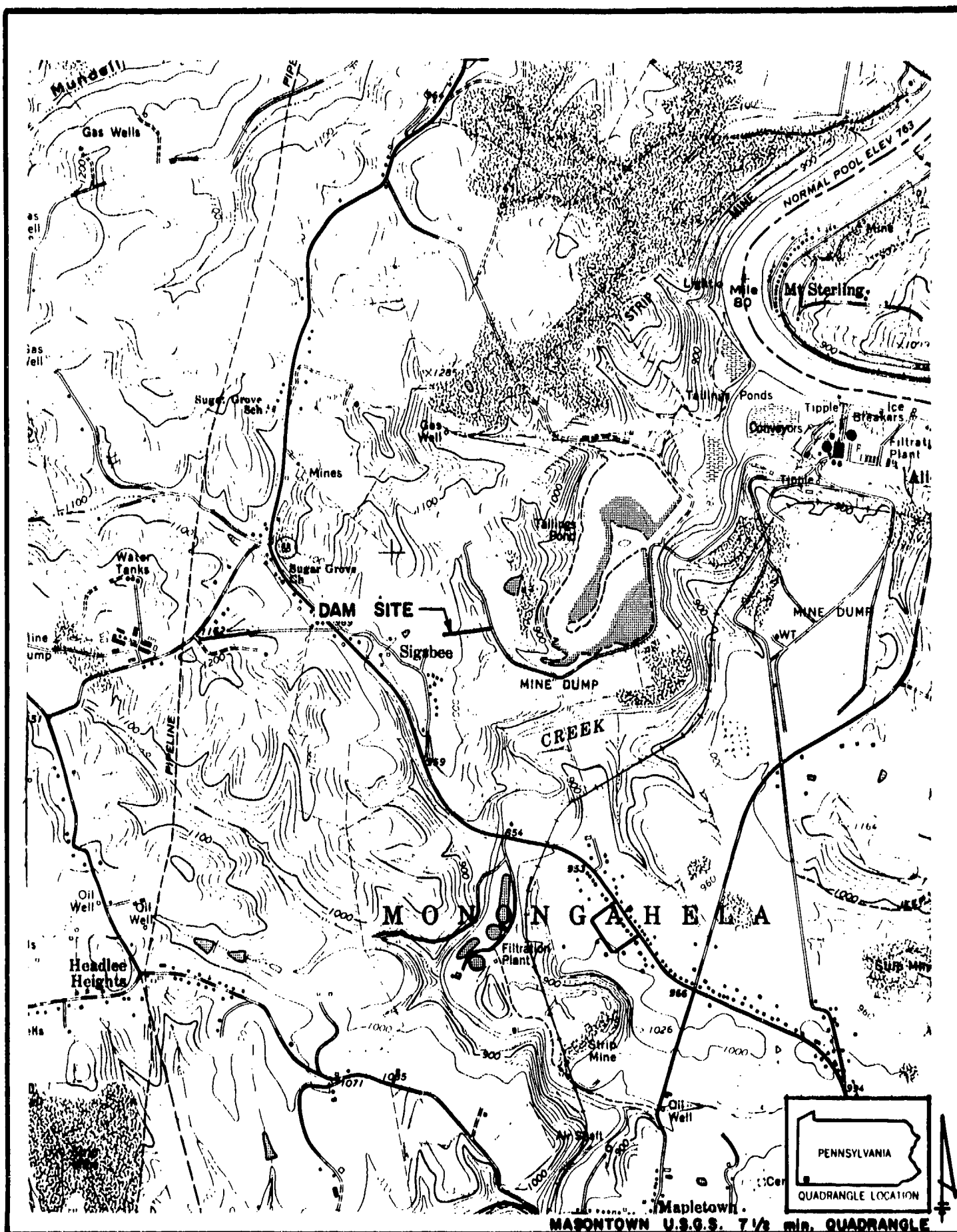


APPENDIX E

PLATES

LIST OF PLATES

Plate I	Regional Vicinity Map
Plate II	Contour Grading Plan, Robena Slurry Impoundment
Plate III	Spillway and Channel Details, Robena Slurry Impoundment
Plate IV	Cross sections at Stations 6+50, 7+00, and 7+50, Robena Settling Pond (Slurry Impoundment)



DATE: JULY 1981

SCALE: 1" = 2000'

DR: JF

CK:

PLATE I

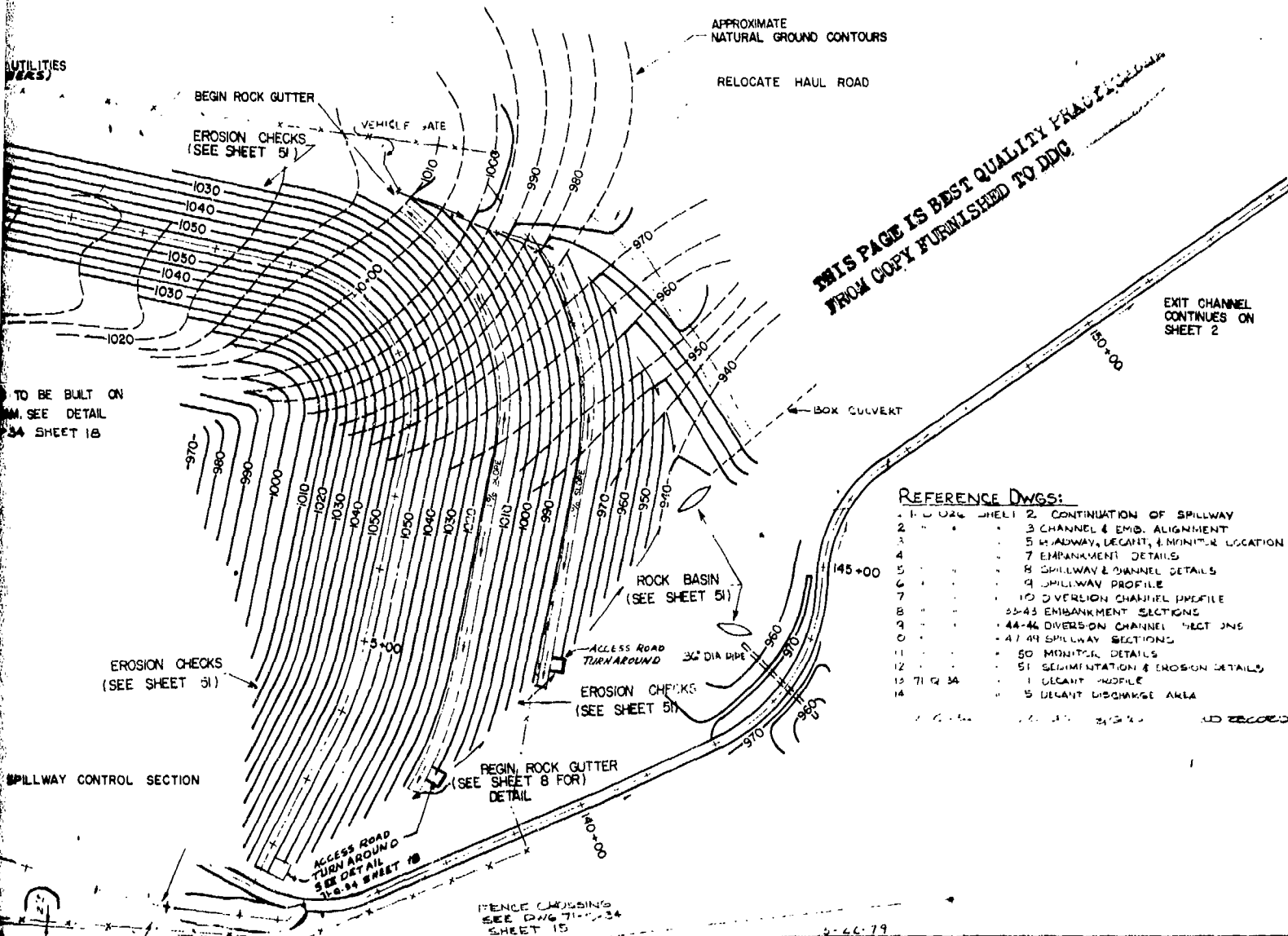
ROBENA SLURRY POND 6
NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES CONSULTING
GEO SYSTEMS, INC. ENGINEERS
1000 BANKSVILLE RD./PITTSBURGH, PA. 15219

REGIONAL
VICINITY
MAP

PR 5717-573

MINE WATER TREATMENT
FACILITIES



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REFERENCE DWGS:

- 1. 11-8-84 SHEET 2. CONTINUATION OF SPILLWAY
- 2. 11-8-84 SHEET 3. CHANNEL & EMB. ALIGNMENT
- 3. 11-8-84 SHEET 4. ROADWAY, DECANT, & MONITOR LOCATION
- 4. 11-8-84 SHEET 5. EMBANKMENT DETAILS
- 5. 11-8-84 SHEET 6. SPILLWAY & CHANNEL DETAILS
- 6. 11-8-84 SHEET 7. SPILLWAY PROFILE
- 7. 11-8-84 SHEET 8. OVERFLOW CHANNEL PROFILE
- 8. 11-8-84 SHEET 9. 33-43 EMBANKMENT SECTIONS
- 9. 11-8-84 SHEET 10. 44-46 DIVERSION CHANNEL SECTIONS
- 10. 11-8-84 SHEET 11. 47-49 SPILLWAY SECTIONS
- 11. 11-8-84 SHEET 12. 50. MONITOR DETAILS
- 12. 11-8-84 SHEET 13. 51. SEDIMENTATION & EROSION DETAILS
- 13. 11-8-84 SHEET 14. 1. DECANT PROFILE
- 14. 11-8-84 SHEET 15. 2. DECANT DISCHARGE AREA

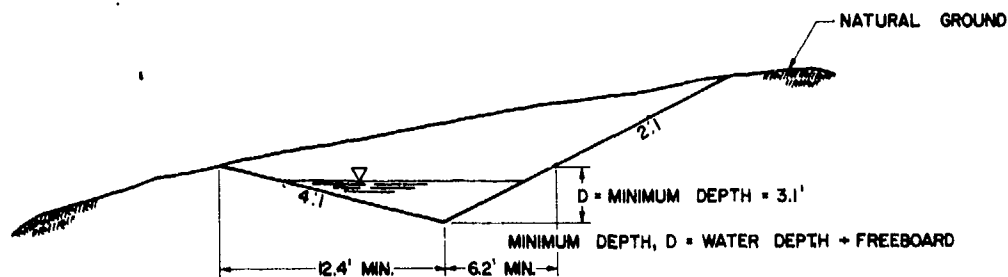
AD RECORD

SEE SHEET 8 FOR PLAN
ENLARGEMENT OF SPILLWAY
ENTRANCE

- REV. 1. ADDED DWG. 71-0-34 SHT. 20
DELINE & EROSION FIELD ZONED
TO LIST OF REFERENCE DRAWINGS
- REV. 2. RELOC. LOCATION OF RELOCATED
25 KV UTILITY LINE.
- REV. 3. REVISED LOCATION OF RELOCATED
25 KV UTILITY LINE.
- REV. 4. ADDED ACCESS ROAD TURN AROUND AND
REMOVED ACCESS ROAD DETAIL.
- REV. 5. ADDED FOREIGN DWG. NO. & CHANGED
TITLE. ADDED "BY OTHERS" NOTES.

AWD	JAH	RWS-21-79	SPEC No. 193-6236-1	APP. No. M2-0019
REFUSE SETTLING BASIN			FD-026	
1/6/81	SEE REV. 1	AVR	U.S. STEEL CORPORATION	
1/23/81	SEE REV. 6	RTM	ROBENA SLURRY IMPOUNDMENT	
1-4-81	SEE REV. 5	CW	FRICK DISTRICT	
9/13/79	SEE REV. 4	RTM	UNIONTOWN, PA.	
9/1/79	SEE REV. 3	RML	CONTOUR GRADING PLAN	
9/6/79	SEE REV. 2	RNL	L. ROBERT KIMBALL	
9/6/79	SEE REV. 1	AVR	CONSULTING ENGINEERS	
DATE			REVISED	BY
DRAWN BY KHC			DATE 9-20-76	CORE NO. 75-0124
CHECKED BY MPC			DATE 10-7-76	SHEET NO. 045
APPROVED BY JJP			DATE 10-8-76	SCALE 1"=100'
			DATE 10-12-76	SHEET NO. 51

PLATE II

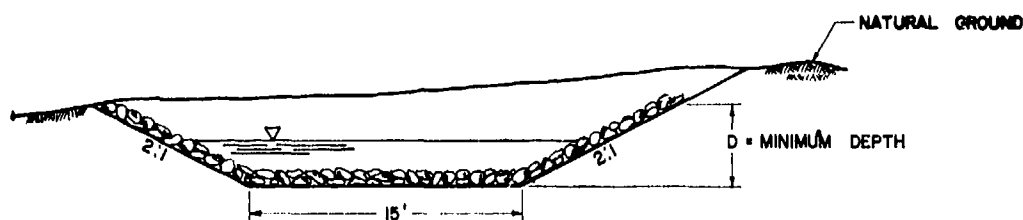


DIVERSION CHANNEL DETAIL

STA. 100+00 TO STA. 134+00

SCALE : 1" = 5'

SEE SHEETS 44 TO 47 FOR CROSS SECTIONS



EMERGENCY SPILLWAY - EXIT CHANNEL DETAIL

STA. 135+06 TO STA. 156+00

NOT TO SCALE - SEE TABULATIONS BELOW

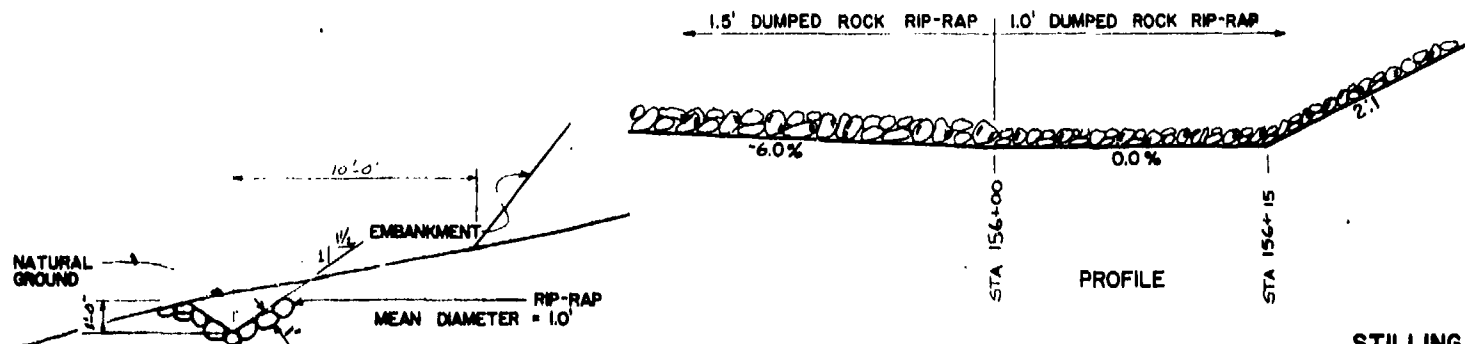
STA. TO	STA.	D (ft.)	RIP-RAP (ft.)
133+00	136+00	4.5'	1.0'
136+00	137+00	5.0'	2.0'
137+00	142+00	4.0'	2.0'
142+00	152+00	4.5'	1.0'
152+00	155+00	4.0'	2.0'
155+00	156+00	5.0'	1.5'
156+00	156+15	STILLING BASIN	

NOTES :

RIP-RAP SIZES LISTED ARE THE MEAN RIP-RAP DIAMETERS REQUIRED. 50% OF THE RIP-RAP SHOULD BE EQUAL TO OR LARGER THAN THE TABULATED DIAMETER.

NO RIP-RAP IS REQUIRED IF CHANNEL IS NOTCHED IN ROCK.

STA. 142+00± TO STA. 145+30± WILL BE COMPLETELY OR PARTIALLY CONSTRUCTED IN FILL.

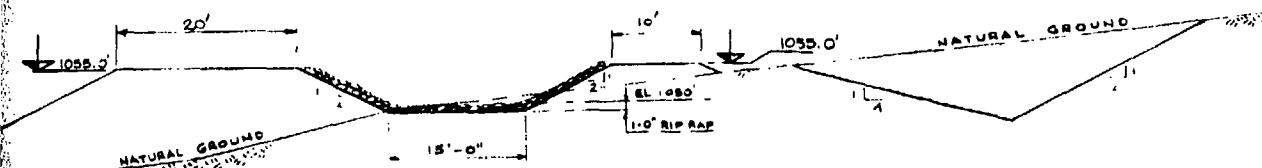


GUTTER DETAIL

NOT TO SCALE

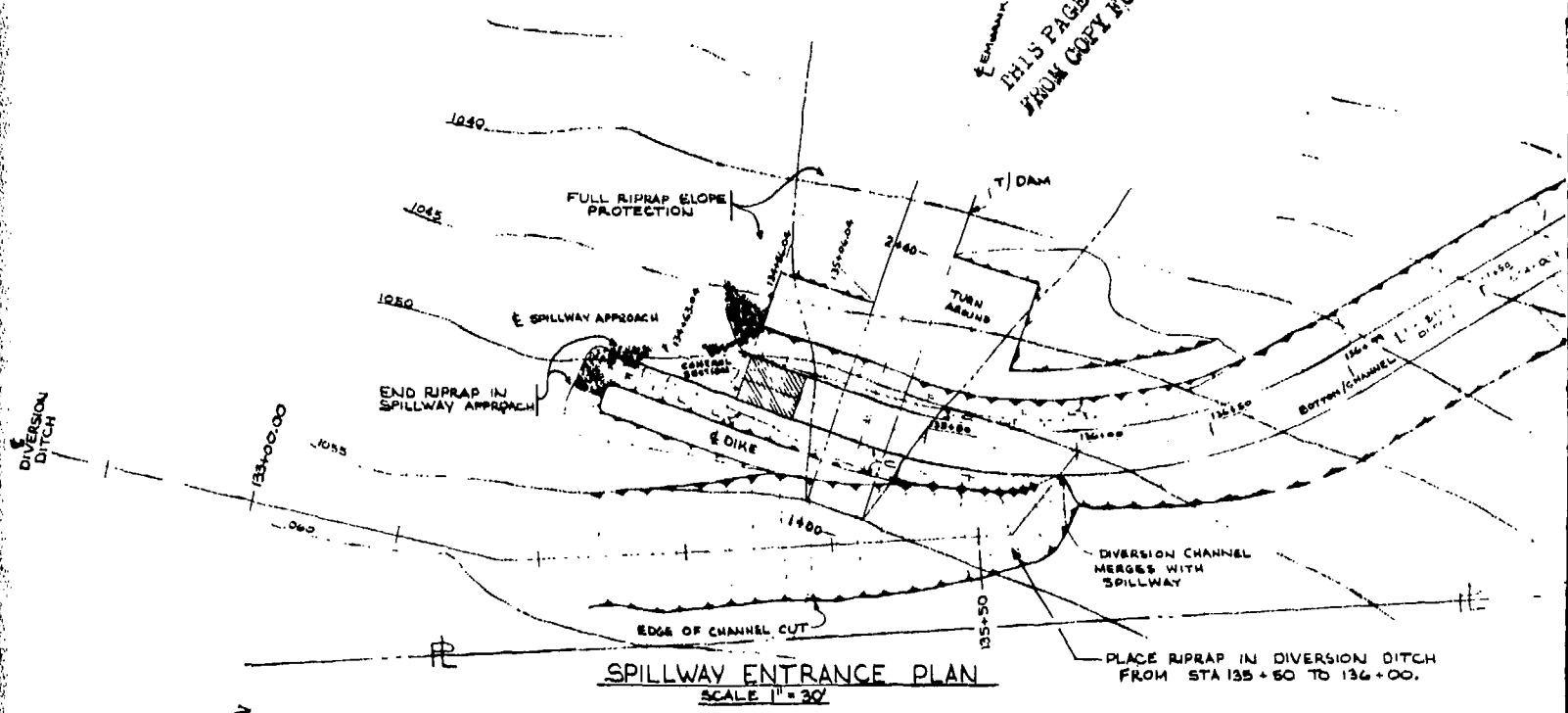
STILLING BASIN D

SCALE : 1" = 5'



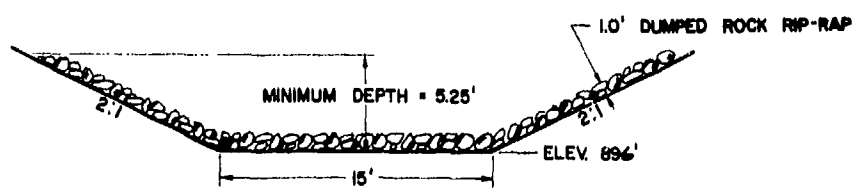
EMERGENCY SPILLWAY CONTROL SECTION
 STA. 134+86.04 TO STA. 135+06.04
 SCALE: 1" = 10'
 MERGING WITH DIVERSION CHANNEL

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REFERENCE DRAWINGS:

- FD-026 - SHEET 3 CHANNEL ALIGNMENT
- FD-026 - SHEET 9 SPILLWAY PROFILE
- FD-026 - SHEET 10 DIVERSION CHANNEL PROFILE
- FD-026 - SHEETS 44 TO 49 CHANNEL & SPILLWAY SECTIONS



CROSS SECTION

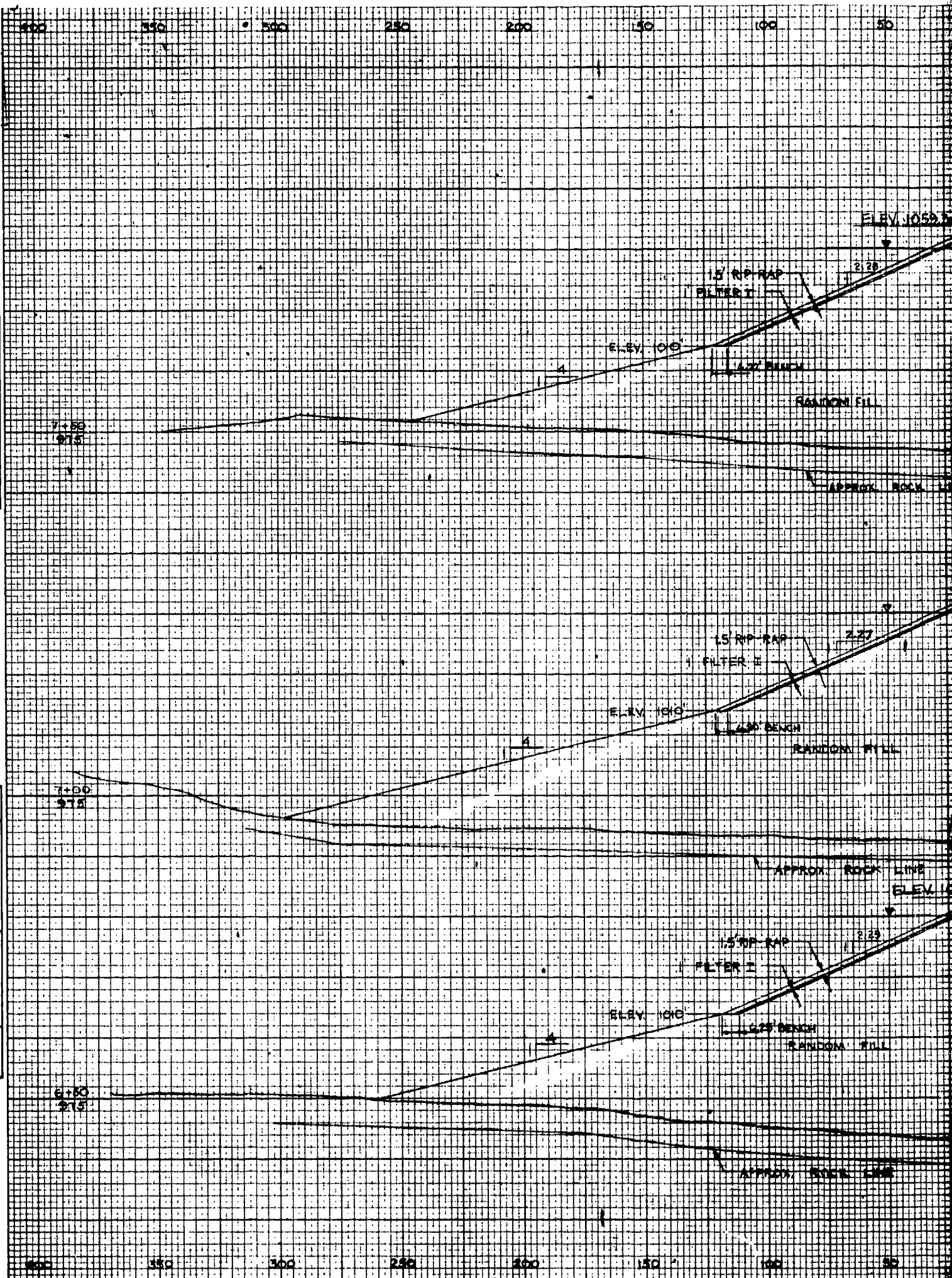
NG BASIN DETAIL
 SCALE: 1" = 5'

SPEC No. MS-6238-1		APPN No. M2-0019		APPROVED JRM		DATE 5-22-79	
REFUSE SETTLING BASIN FD-026							
SEE SHEETS 1 & 2 FOR CHANNEL & SPILLWAY LOCATION SEE SHEETS 9 & 10 FOR CHANNEL & SPILLWAY PROFILES							
U.S. STEEL CORPORATION ROBENA SLURRY IMPOUNDMENT FRICK DISTRICT UNIONTOWN, PA.							
SPILLWAY & CHANNEL DETAILS							
L. ROBERT KIMBALL CONSULTING ENGINEERS PITTSBURGH, PENNSYLVANIA							
DRAWN BY JAK		DATE 10-9-78		CODE NO. 75-0124		SHEET NO. 8	
TRACED BY MPC		DATE 10-11-78		SCALE AS NOTED		OF 81	
CHECKED BY JAK		DATE 10-12-78		APPROVED BY JRM		DATE 10-12-78	

REV	DESCRIPTION
1	RELOCATED SPILLWAY AT WEST ABUTMENT, CHSD STILLING BASIN LOCATION & ELEV. ADDED R.D. NUMBER. CHSD DWS TITLE, CHSD GUTTER DETAIL.

DATE	
BY	
SUPERVISOR	
PLATTED	
TEMPLATE	
NOTE BOOK	
AREAS	
AREAS CHECKED	

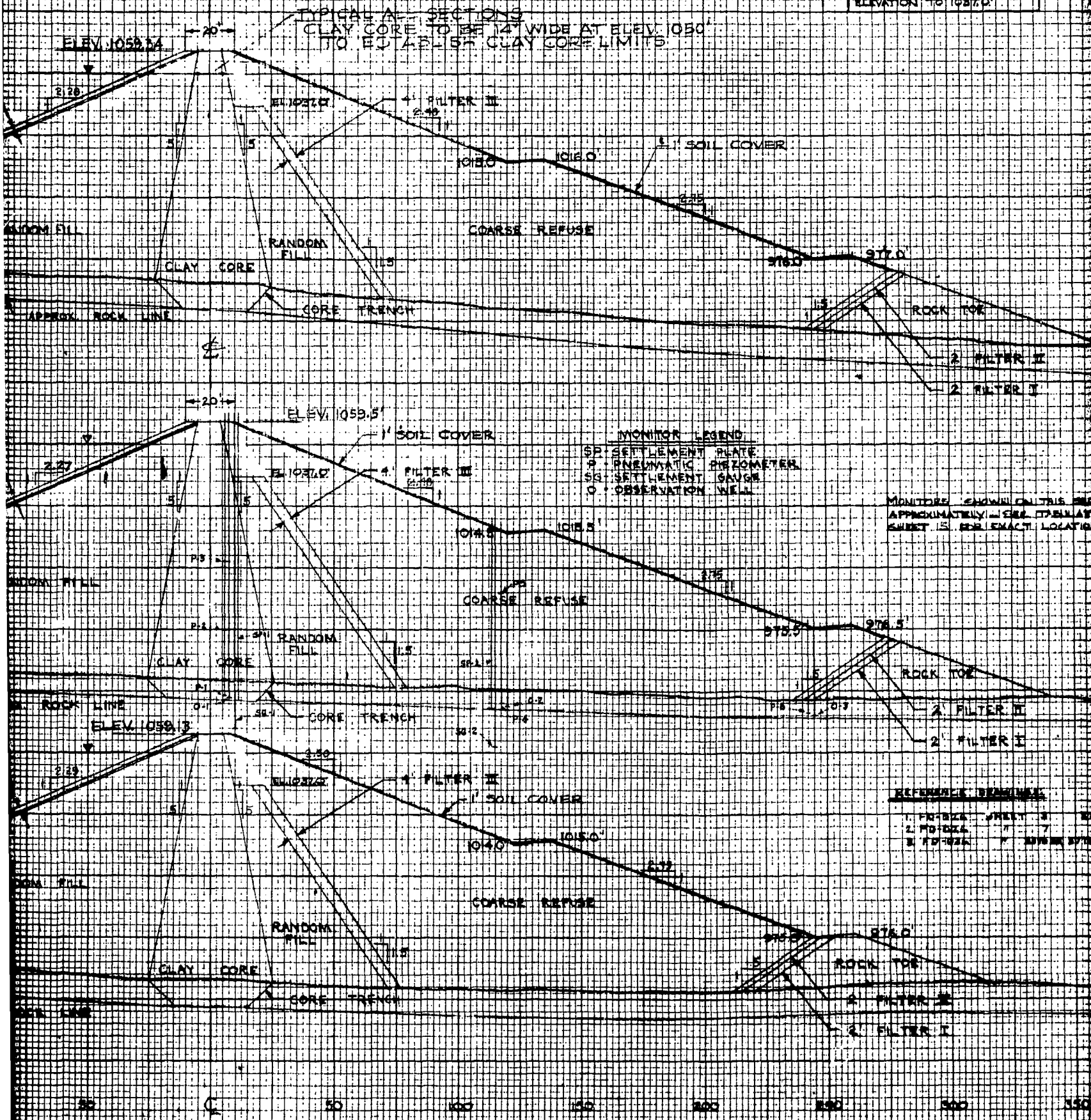
DATE	
BY	
SUPERVISOR	
PLATTED	
TEMPLATE	
NOTE BOOK	
AREAS	
AREAS CHECKED	



REFUSE SETTLING BAS

11-4776 APR SPEC No. 192-6778-1
ADDED FOREIGN DWG. NO.
CORRECTED MONITOR LOCATION
TO CORRESPOND WITH KINBAULT
DEC. 2 REVISION.
CORRECTED TOP OF FILTER 3
ELEVATION TO 1087.0

TYPICAL A-A SECTIONS
CLAY CORE TO BE 14" WIDE AT ELEV. 1080
TO ESTABLISH CLAY CORE LIMITS



MONITOR LEGEND
SP SETTLEMENT PLATE
P PNEUMATIC PIEZOMETER
SG SETTLEMENT GAUGE
O OBSERVATION WELL

MONITORS SHOWN ON THIS SHEET
APPROXIMATELY IN SEE OPERATING
SHEET 15 FOR EXACT LOCATION

REFERENCE DRAWINGS
1. PD-1024 SHEET 3
2. PD-1024 SHEET 7
3. PD-1024 SHEET 17

U S STEEL CORPORATION
ROBENA SETTLING PONDS
SCALE : 1" = 25'

SE SETTLING BASIN FD-026

DATE SPEC IN 12-6238-1 DESIGNATE 12-0015

U FOREIGN DWS NO. APPD JAN 1977 REVISION 12

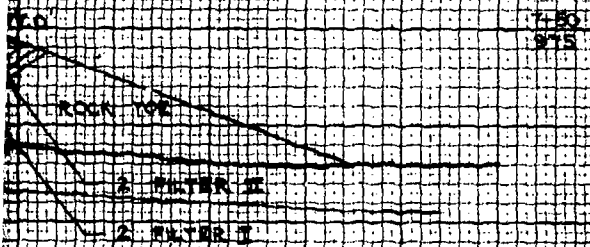
REVISION MONITOR DEIGNED

REVISION WITH KINBAID

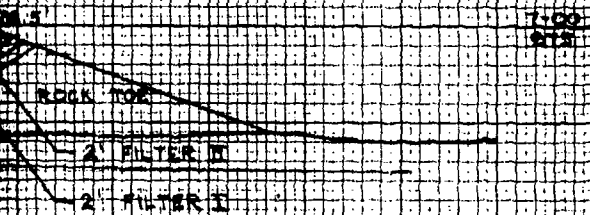
REVISION

REVISION TOP OF FILTERS

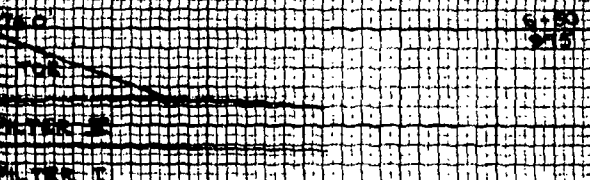
REVISION TO 10870



MONITORS SHOWN ON THIS SECTION ARE LOCATED
APPROXIMATELY - SEE DETAIL ON FIELD
SHEET 15 FOR EXACT LOCATION



REFERENCE SHEET
1. FILTER SHEET 2. EMBANKMENT ALIGNMENT
3. FILTER 4. DETAILS
5. FILTER 6. SECTION



APPENDIX F

GEOLOGY

GEOLOGY

Geomorphology

Robena Slurry Pond 6 is located within the Pittsburgh Plateau section of the Appalachian Plateau Physiographic Province. This area is characterized by gently folded sedimentary rocks which have been incised by streams to form steep sided valleys. The site is located near the head of an unnamed tributary to Whiteley Creek. The valley bottom of the unnamed tributary is about 360 feet below the adjacent hilltops. These rounded hilltops are at Elevation 1200 to 1300 feet, and in a regional sense are part of a broad, undulating plateau.

Structure

The site lies on the eastern flank of the Lambert Syncline, the axis of which plunges to the northeast. Strata in the immediate vicinity of the dam, however, dip to the north at a rate of about 0.8 degree. Faulting has not been documented in the area of the dam and no observations were made that would indicate faulting in the rocks outcropping around the dam.

Stratigraphy

Rocks outcropping in the immediate vicinity of the site belong to the Pennsylvania Age Monongahela Formation and the Permian Age Dunkard Group. The major rock types in all these formations are cyclic sequences of shale, limestone, sandstone, and coal.

Mining Activity

The Pittsburgh Coal Seam, the lowermost unit of the Monongahela Formation, lies about 240 feet below the dam and has been affected by deep mining. The Waynesburg Coal Seam, which is the lowermost unit of the Waynesburg Formation, outcrops in the valley walls adjacent to the dam and may have been affected by strip mining.



MASONTOWN QUADRANGLE, GREENE COUNTY, PENNSYLVANIA

SCALE: 0 1/2 MILE 1:24000
 CONTOUR INTERVAL 20 FT. DATUM IS MEAN SEA LEVEL
 ——— FORMATION CONTACT

DATA OBTAINED FROM PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY GREATER PITTSBURGH REGION
 GEOLOGIC MAP AND CROSS SECTIONS, 1975 and GREATER PITTSBURGH REGION STRUCTURE CONTOUR MAP, 1975

DATE: JULY 1981

SCALE: 1"=2000'

DR: JF CK: JEB

ROBENA SLURRY POND 6

NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES CONSULTING ENGINEERS

GEO SYSTEMS, INC.

1000 BANKSVILLE RD./PITTSBURGH, PA. 15219

GEOLOGIC
MAP

AGE	SYMBOL	2-1537	COLUMNAR SECTION	PROMINENT BEDS
QUATERNARY		Q1		PLEISTOCENE GLACIAL OUTWASH, RIVER TERRACE DEPOSITS AND ALLUVIUM
PERMIAN	DUNKARD (P4)	GREENE (P5)		UPPER WASHINGTON LIMESTONE
		WASHINGTON (P4)		WASHINGTON COAL
		WAYNESBURG (P4)		WAYNESBURG SANDSTONE
		WAYNESBURG (P4)		WAYNESBURG COAL
		UNIONTOWN (P4)		UNIONTOWN SANDSTONE
		UNIONTOWN (P4)		UNIONTOWN COAL
		BENWOOD (P4)		BENWOOD LIMESTONE
		SEWICKLEY (P4)		SEWICKLEY COAL
		PITTSBURGH (P4)		PITTSBURGH SANDSTONE
		PITTSBURGH (P4)		PITTSBURGH COAL
PENNSYLVANIAN	CONEMAUGH (P3)	CONNELLSVILLE (P3)		CONNELLSVILLE SANDSTONE
		MORGANTOWN (P3)		MORGANTOWN SANDSTONE
		AMES (P3)		AMES LIMESTONE
		PITTSBURGH (P3)		PITTSBURGH REDBEDS
		SALTSBURGH (P3)		SALTSBURGH SANDSTONE
		MAHONING (P3)		MAHONING SANDSTONE
		UPPER FREEPORT (P3)		UPPER FREEPORT COAL
		UPPER KITTANNING (P3)		UPPER KITTANNING COAL
		WORTHINGTON (P3)		WORTHINGTON SANDSTONE
		LOWER KITTANNING (P3)		LOWER KITTANNING COAL
CARBONIFEROUS	POTTSVILLE (P2)	HOMERWOOD (P2)		HOMERWOOD SANDSTONE
		MERCER (P2)		MERCER SANDSTONE, SHALE & COAL
		CONNOQUENESSING (P2)		CONNOQUENESSING SANDSTONE
		BURGESS (P2)		BURGESS SANDSTONE
		CUYAHOGA (P2)		CUYAHOGA SHALE
DEVONIAN	POCONO (P1)	BEREA (P1)		BEREA SANDSTONE

DATE: JULY 1981

SCALE: 1"=360

DR: JF CK: JEN

ROBENA SLURRY POND 6
NATIONAL DAM INSPECTION PROGRAM

ACKENHEIL & ASSOCIATES CONSULTING

GEO SYSTEMS, INC. ENGINEERS

1000 BANKSVILLE RD./PITTSBURGH, PA. 15216

GEOLOGIC
COLUMN